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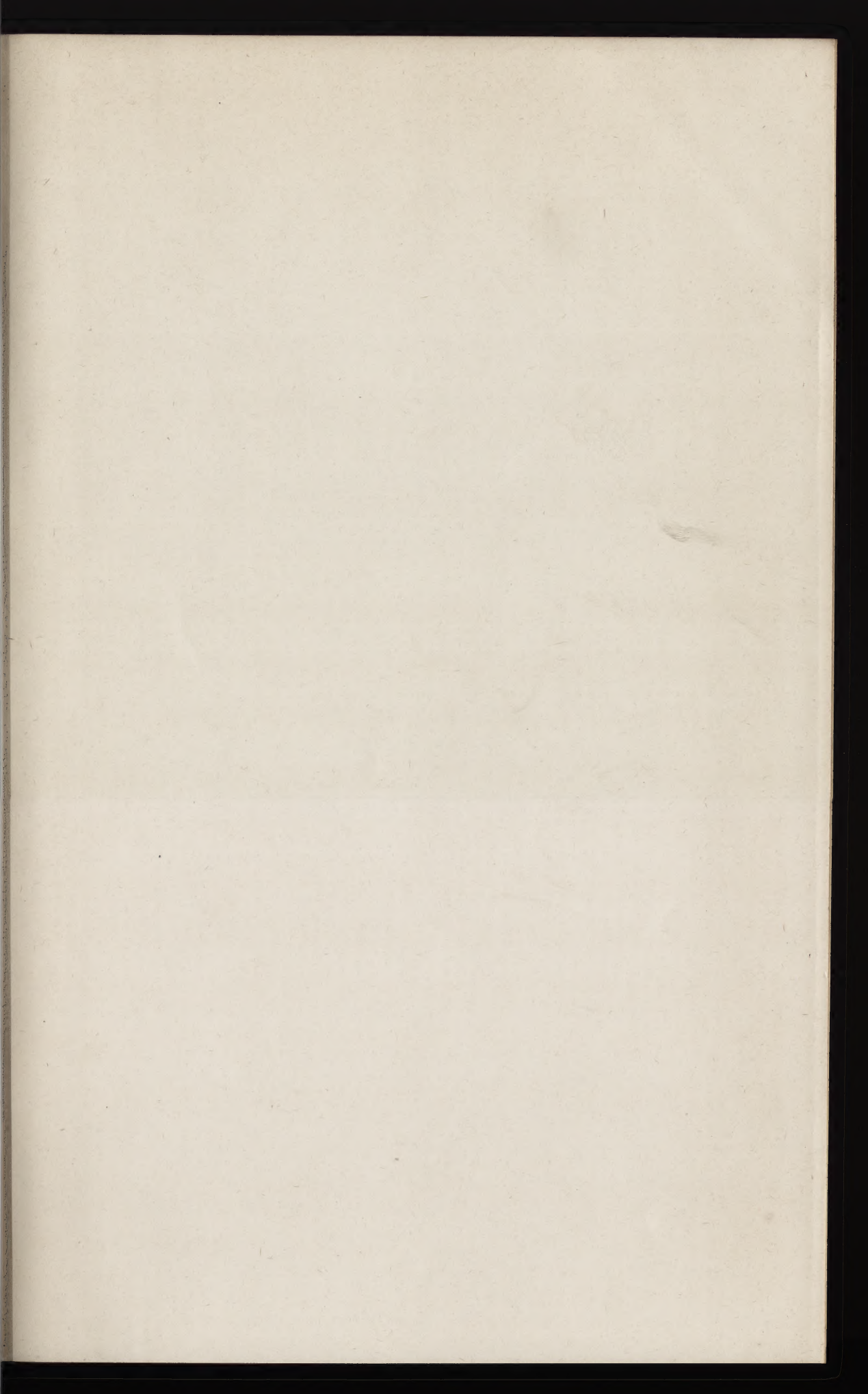
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# AMERICAN JOURNAL OF PHYSICAL ANTHROPOLOGY

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# AMERICAN JOURNAL OF PHYSICAL ANTHROPOLOGY

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# American Journal of Physical Anthropology

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NUMBER 1

## NEW DISCOVERIES OF NEANDERTAL MAN AT LA QUINA AND LA FERRASSIE

GEORGE GRANT MacCURDY

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In respect to the number of Mousterian skeletons represented, La Quina in Charente and La Ferrassie in Dordogne rank among the first of paleolithic stations. Largely because of this La Quina has become a *pied à terre* of the American School in France for Prehistoric Studies. It was the hope of finding skeletal remains of Mousterian or Neandertal man that kept the students of the School on the *qui vive*, putting forth their very best efforts for eight long weeks of digging during the summer of 1921 at La Quina M. They were not successful in this respect, but they had the satisfaction of seeing the human teeth which Dr. Henri-Martin found in the adjoining station of La Quina<sup>1</sup> on September 8th and 9th. This find consisted of a second lower left molar, a third left molar, a first upper right pre-molar with two roots, and an incisor. All are massive and probably belong to one individual, an adult.

A much more important discovery was made by the wife of Dr. Henri-Martin in 1915, he being at the front at that time in the service of his country. In the section at La Quina C and in the same horizon (C2) where the recent find of teeth was made, Madame Henri-Martin noted what appeared to be the vertex of a child's skull which had come to view through chance in the process of weathering. She at once notified her husband who immediately returned to La Quina. The cranium proved to be that of a child about eight years of age. The lower jaw is lacking, but the cranium is almost complete and not altered by post-mortem pressure in the deposit. It is so nearly perfect as to throw new light on the ontogeny of Neandertal man.

<sup>1</sup> La Quina A, B, C, and D now belong to the French Government.

Practically all the distinguishing features of the race are present, so that the Neandertal child of eight years resembled the adult of his race more closely than the modern child resembles the adult of his race.<sup>2</sup> There is present, however, one feature of the face which had not been anticipated. All Neandertal crania thus far discovered are more or less fragmentary; among the parts easily lost and usually missing are the nasal bones. It has been assumed that Neandertal man had a flat, broad nose, and all attempted reconstructions reproduce him as possessing such a nose. Fortunately the nasal bones are present in this eight-year-old child, and by their shape prove that Mousterian man had a well-developed nasal bridge. However, that which has been revealed in this child from La Quina might have been predicted after the discovery at La Chapelle-aux-Saints. No nasal bones were found with the skull of La Chapelle-aux-Saints, it is true; but the frontal processes of the superior maxillaries were present and the structure of those portions bordering on the nasal bones now missing is just such as would be required for a pronounced nasal bridge.

Before leaving La Quina it is worth while to recapitulate the finds of Neandertal skeletal remains by Dr. Henri-Martin, including La Quina M, the site recently turned over to the American School:

- 1) 1908.—Two astragali found in fairly close proximity, right and left, presumably belonging to the same individual (couche C3).<sup>3</sup>
- 2) 1908.—Fragments of an occipital, including the right half of the occipital protuberance (B2).
- 3) 1910.—Dorsal vertebra (C2).
- 4) 1911.—Second lower right molar and third lower left molar. Found about one meter apart, but both belonging apparently to the same individual (C2).
- 5) 1911.—Part of an adult female skeleton including a nearly complete cranium and lower jaw, the most important discovery of the series (B2).
- 6) 1912.—Fragment of a parietal (B2).
- 7) 1912.—Part of the right half of a frontal with a considerable portion of the brow ridge (C2).
- 8) 1912.—Part of the left half of a frontal with a portion of the brow ridge (C2).
- 9) 1912.—Left ramus of a lower jaw with the two premolars and the three molars in place (C2).
- 10) 1913.—Left temporal (B3).
- 11) 1913.—Fragment of occipital (M2).
- 12) 1913.—Fragment of left frontal (M2).

<sup>2</sup> Henri-Martin. *L'Anthropologie*, XXXI, Nos. 3-4, 1921. Also *Bull. & Mém. Soc. Anthropol.*, Paris, 1920, n. s. I, 113-125.

<sup>3</sup> All the horizons at La Quina are of Mousterian age. Dr. Martin numbers from the top down, so that C3 means Section C, third horizon from the top.

- 13) 1913.—Left parietal (*M2*).
- 14) 1908.—Left parietal (*H1*).
- 15) 1913.—Right parietal of a youth (*B2*).
- 16) 1913.—Median fragment of left temporal (*C2*).
- 17) 1913.—Lower left canine (*C1*).
- 18) 1915.—Cranium of a child about eight years old (*C2*).
- 19) 1920.—Left patella (*B3*).
- 20) 1921.—Second lower left molar, third lower left molar, first upper right pre-molar with two roots, and incisor; all are massive and apparently belong to the same individual (*C2*).

La Ferrassie in the Vézère valley near Bugue is likewise the site of recent discoveries of Neandertal skeletal remains. From 1909 to 1912, four skeletons of Mousterian age were found in the rock shelter. Two were those of adults and two those of children. In 1920 the skeleton of a new-born infant was found in Mousterian deposits. The sixth skeleton, that of a child some seven or eight years old, was discovered likewise in Mousterian deposits in 1921. The position of the calotte was more than half a meter from the sepulture containing the rest of the skeleton, which was covered by a large stone with cupules,—the pitted surface underneath—that is, next to the human remains.

There are several superposed Aurignacian horizons at La Ferrassie; in these Capitan and Peyrony have discovered some interesting early works of art.





## STATURES AND WEIGHTS OF CHILDREN UNDER SIX YEARS OF AGE

ROBERT M. WOODBURY

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The final bulletin giving the results of the statistical analysis of the material gathered during Children's Year on statures and weights of children under six years of age has been issued by the Children's Bureau.<sup>1</sup> A preliminary statement of the plans for tabulation was published in this *Journal* in 1919.<sup>2</sup> In the present note the principal findings of the report are summarized.

The data used in the report were selected from over 2 million records of heights, weights and other particulars relating to children under 6 years of age, who were weighed and measured in all parts of the country during Children's Year.

The report is divided into two parts, the first relating to average heights and weights and based upon material drawn from all parts of the country, the second dealing with the prevalence of defects and the relation of defects to height and weight based upon data from California and New York City.

In the tabulation of heights and weights a total of 172,000 cards was included. The basis of selection was fourfold: (1) The record card must have been signed by a physician; (2) serious defects must not have been noted; (3) the child must have been weighed and measured without clothing, as verified by the physician signing the card; and (4) all essential items on the card must have been answered. The cards were divided at the outset into two groups, white children numbering 167,024 and negro children numbering 4,976. All the children were under 7 years of age and practically all were under 6; in the group of white children the number of each sex at each month of age from 1 to nearly 60 months was 1,000 or over.

<sup>1</sup> Statures and Weights of Children Under Six Years of Age, By Robert Morse Woodbury, Ph.D., Children's Bureau, U. S. Department of Labor, Pub. 87, Wash., 1921.

<sup>2</sup> Heights and Weights of Children Under Six. *Am. J. Phys. Anthropol.*, II, No. 2.

*AM. J. PHYS. ANTHROP.*, Vol. V, No. 1.

Boys are found to be slightly taller and heavier than girls of the same ages. The averages for boys increase from 55.5 cm (21.85 inches) and 4.53 kilograms (9.98 lbs.) at 1 month of age to 111.1 cm (43.73 inches) and 18.70 kilograms (41.23 lbs.) at 71 months. At the same time those for girls increase from 54.4 cm (21.43 inches) and 4.27 kilograms (9.42 lbs.) at 1 month of age to 110.2 cm (43.40 inches) and 18.22 kilograms (40.16 lbs.) at 71 months. The boys average about a centimeter taller and half a kilogram heavier than the girls.

Not only are boys heavier than girls of the same ages but they are slightly heavier than girls of the same heights. The average weight for boys 50.8 cm (20 inches) in height is 3.71 kilograms (8.19 lbs.), as compared with 3.69 kilograms (8.13 lbs.) for girls; while the average weight for boys 119.4 cm (47 inches) in height is 21.45 kilograms (47.29 lbs.), as compared with 21.25 kilograms (46.85 lbs.) for girls. The differences in favor of the boys are relatively much smaller when average weights are taken for children of the same heights than when average weights are taken for children of the same ages.

The relationship existing between weight, height and age is shown to be principally determined by the dependence of height upon age and the dependence of weight upon height. For children between 2 and 6 years of age, or between 88.9 cm (35 inches) and 119.4 cm (47 inches), age seems not to affect weight except as it influences height. Among children under 2 years, and especially among children under 6 months of age, however, age appears to have an influence upon weight independent of height, and the younger the age the less the average weights of children of the same heights. For boys 58.4 cm (23 inches) in height, for example, the average weight increases from 4.76 kilograms (10.50 lbs.) at one-half month to 5.16 kilograms (11.38 lbs.) at one and one-half months, 5.47 kilograms (12.05 lbs.) at two and one-half months, 5.63 kilograms (12.41 lbs.) at three and one-half months, and 5.69 kilograms (12.54 lbs.) at four and one-half months. In contrast to this regular increase in average weight of these young boys as age advances, the average weight of boys 106.7 cm (42 inches) in height remains nearly constant—17.48 kilograms (38.34 lbs.), 17.40 kilograms (38.37 lbs.), 17.39 kilograms (38.34 lbs.) and 17.47 kilograms (38.51 lbs.)—for boys aged three and one-half, four and one-half, five and one-half and six and one-half years respectively.

The variabilities of statures and weights are shown for boys and girls separately for each month of age, as well as the variabilities in weights for children of different heights. Two measures of variability are given,



the standard deviation and the coefficient of variation. The standard deviation of stature shows a slight decrease both for boys—from 3.6 cm (1.43 inches) at age one-half month to 3.2 cm (1.25 inches) at two and one-half months,—and for girls—from 3.5 cm (1.39 inches) at one-half month to 3.1 cm (1.24 inches) at two and one-half months; but from this point the standard deviation increases, reaching about 5 cm (2 inches) for both boys and girls at 71½ months. The standard deviations of weights show no such decrease in the first two or three months of life as appears in those of heights, but increase from 0.80 kilograms (1.77 lbs.) for boys and 0.78 kilograms (1.72 lbs.) for girls at one-half month to about 2.18 kilograms (4.8 lbs.) for both boys and girls at 71½ months. The coefficient of variation of height, found by dividing the standard deviation by the average for the corresponding ages, decreases from 6.7 per cent for boys and 6.6 per cent for girls at one-half month of age to about 4.6 per cent at ages just under 6 years. The coefficient of variation of weight is relatively much greater than that of height, decreasing from 19.4 per cent for boys and 19.9 per cent for girls at one-half month to about 11.5 per cent for boys and girls at 71½ months. During the early months of life the decrease is especially rapid; in fact, there appears to be but little change in the coefficient of variation from about the 12th to the 72nd months.

The coefficient of variation of weight when the children are classified by height is found to be markedly smaller than when they are classified by age. The decrease in this coefficient is also more marked, for it falls from 16.7 per cent for boys and 16.4 per cent for girls of 50.8 cm (20 inches) in height to 7.1 per cent for boys and 8.9 per cent for girls of 119.4 cm (47 inches) in height.

Comparisons are made in the report with two other series of data for American children under 6 years of age. In general most of the series of heights and weights of children have been based upon measurements at birth or measurements of school children between 5 and 16 years of age. The two principal series of average heights and weights in common use for children under 6 years of age are figures compiled by Dr. F.S. Crum<sup>3</sup> for the American Medical Association based upon 10,423 children aged 6 to 48 months of age inclusive, and data published by L. Emmett Holt, M.D. based upon measurements of children in private practice.<sup>4</sup> The

<sup>3</sup> Anthropometric Statistics of Children—Ages 6 to 48 months. Frederick S. Crum, *Pub. Am. Statis. Asso.*, Vol. XV, 1916-17, 332-336.

<sup>4</sup> L. Emmett Holt, M. D. *Diseases of Infancy and Childhood*, Ed. 1916, 20, and Ed. 1919, 19.

average statures of the Children's Year series are practically identical with those of Dr. Crum's series from 6 to 12 months, but are very slightly lower at ages over 12 months, the difference increasing up to 1.0 cm (0.39 inches) for boys and 0.8 cm (0.31 inches) for girls between 36 and 48 months. In average weight the Children's Year series falls considerably below Dr. Crum's figures. The average difference rises from 0.17 kilograms (0.37 lbs.) for boys and 0.12 kilograms (0.27 lbs.) for girls between 6 and 12 months to 0.47 kilograms (1.03 lbs.) for boys and 0.44 kilograms (0.96 lbs.) for girls between 36 and 48 months of age.

It should be noted, however, that at ages over 3 years the numbers upon which Dr. Crum's averages were based were relatively small, ranging from 9 to 90 and averaging only 28 cases at each age. Furthermore, since Dr. Crum's series was based upon measurements of infants who were brought for baby welfare conferences or for "baby shows" in many of which prizes were given the most perfectly developed children, the tendency may well have been to bring only the larger and heavier babies.

In reference to Dr. Holt's figures, it should be noted that he has published two series of averages; the earlier one is contained in the edition of his "Diseases of Infancy and Childhood" of 1916 and preceding years, and the later one in the edition of the same work published in 1919. Slight differences in average statures appear between the earlier and the later series; the average statures of the children examined during Children's Year fall between the two series of measurements given by Dr. Holt, being relatively closer to the later than to the earlier figures. In weight Dr. Holt's two series are identical at 6 months and at 1 year, but at 2, 3 and 4 years the children in the later series averaged about a quarter of a kilogram ( $\frac{1}{2}$  lb.) heavier. The Children's Year averages at 6 months are slightly above Dr. Holt's for both boys and girls, at 12 months practically identical for boys but somewhat lower for girls, and at older ages somewhat lower than Dr. Holt's figures for both boys and girls. In regard to weight for age the Children's Year figures are somewhat closer to the earlier than to the later series.

Another point of comparison is in regard to average weight for height. The Children's Year averages are somewhat below Dr. Crum's in this respect, but are very close to the averages for boys, though somewhat below those for girls, of Dr. Holt's later series.

A comparison is also made with Bowditch's averages for Boston school children at  $5\frac{1}{2}$  years. In stature the averages of the Children's Year series are slightly above Bowditch's; in weights, when allowance is

made for the fact that the Boston children were weighed in ordinary clothing, the Children's Year series appears to agree fairly well with Bowditch's at the point of juncture.

The 167,024 white children upon whom the averages under discussion were based were drawn from all parts of the country although certain sections were much more fully represented than others. In particular, the State of Iowa was represented by 37,000 children, over one-fifth of the total number in the series. Besides Iowa, California and the East-North-Central States were represented more fully than the average for the entire country; other States, particularly those in the South, were under-represented.

In regard to nativity and racial composition of the white children included in the tabulation, 69.3 per cent had both parents born in the United States, as compared with 70.2 per cent of white children under 5 years of age in the whole country according to the census of 1910. In this respect, therefore, the white children tabulated were typical of all the white children in the United States.

A partial analysis of racial stocks probably represented among the white children of native parentage can be made on the basis of racial stocks in the population of the States in which the children lived; for the children of foreign or mixed parentage the original records gave the country of birth of the parents. The conclusions are reached that in the group of children of native parentage the German and the Scandinavian stocks were perhaps more fully represented than in the population as a whole; in the group of children of foreign born parentage Germany, Great Britain and Ireland were represented in slightly smaller proportions, while Italy, Austria-Hungary, and perhaps Poland were represented in slightly larger proportions than in the total foreign-born population.

Since, as shown later in the report, children of Scandinavian and German parentage are slightly taller and heavier and children of Italian parentage considerably shorter and lighter than the averages for all white children, the effects of these tendencies in the selection of the children would to some extent offset one another. In any case the amount of error in the general average due to bias in over-representation of certain racial stocks is small, because any such over-representation was very slight in comparison with the total numbers involved. The conclusion is drawn, therefore, that in racial stocks the group selected for tabulation was fairly typical of the white children under 6 years of age in the United States.



The group of white children was further analyzed to determine comparative height and weight in different sections of the country. Three sections,—two represented by over 30,000 and one by nearly 20,000 children,—were selected, Iowa, California and New York City. The averages for children in Iowa are very close to those for children in the country as a whole, the Iowa children being slightly taller (0.5 cm, 0.20 inches, for boys, and 0.4 cm, 0.14 inches, for girls) and very slightly lighter (0.02 kilograms, 0.04 pounds, for boys, and 0.02 kilograms, 0.05 pounds, for girls). In weight the Iowa children under 1 year of age, contrary to the tendency of those aged over 1 year, are slightly above the average. In California, on the other hand, the children average about 1 cm (0.40 inches for boys and 0.36 inches for girls) taller than children in the country as a whole while they average 0.34 kilograms (0.75 lbs.) heavier. In New York City the average stature is 1.3 cm (0.52 inches) for boys and 1.2 cm (0.49 inches) for girls below the average for the country as a whole; the average weights are not exactly comparable since the children of New York City were weighed in under-clothing.<sup>5</sup>

In Iowa the German and Scandinavian stocks were represented among the children included in the tabulation in slightly larger proportions than in the country as a whole, and the slight difference between the average heights of children in Iowa and of children in the whole country may perhaps be due to this slight over-representation of German and Scandinavian stocks. In California, however, the Southern European races, especially the Italian, were slightly over-represented as compared with the whole country, and the marked excess in height and weight of children in California cannot, therefore, be accounted for by the nationality stocks of the children included in the tabulation. Other factors, selection of the tallest and heaviest in the process of migration, climate, or conditions favorable to the growth and development of children, must therefore be responsible for this excess in stature and weight. In New York City a large proportion of the children examined were children of short statured races, notably the Jewish and Italian, and therefore the deficiency in stature may be accounted for in this case by the nationality composition of the group examined.

A special study was made to determine whether country and city children differed in average stature and weight. For this purpose the children examined in Iowa and in the East-North-Central group of

<sup>5</sup> The New York City children were not included in the general averages.

States, including Minnesota, Wisconsin, Illinois, Indiana and Michigan were selected. The children were tabulated by the size of the communities in which they were examined, whether "rural," which was defined as communities of under 10,000 population, or "urban," which was divided into communities of from 10,000 to 25,000 population and communities of 25,000 and over. Both in stature and weight the averages for children in the rural communities are slightly above those for children in the urban communities. The amount of difference, however, is slight, being about 0.6 cm (0.25 inches) in stature and about 0.10 kilograms (0.22 lbs.) in weight. In this comparison only children whose parents were native born were included, eliminating so far as the material permitted any difference in racial stock between country and city populations. Since the parents of these children were for the most part born in this country before 1890 they included no appreciable proportion of persons of short statured races, such as the Italian and Jewish. The evidence indicates, moreover, that the Scandinavians, a tall people of whom there was a considerable proportion in these areas, lived more largely in cities than in country districts; the presence of this race element, therefore, would not explain the difference in stature and weight in favor of the country.

An analysis is also made of the stature and weight of children of native parentage as compared with the stature and weight of the entire group. The native group used in this comparison also was limited to children in Iowa and the East-North-Central States. The averages for these children are found to agree very closely with the averages for all children, the difference being only 0.1 cm (0.05 inches) in height in favor of the children of native parentage and about 0.03 kilograms (0.06 lbs.) in weight in favor of all the children included in the tabulations.

Three nationality groups were selected for special study—children of mothers born in Italy, children of mothers born in Scandinavia, and children of mothers born in Germany. The averages for the Italian children are markedly below those for all white children both in stature and weight. In stature the Italian boys average 2.7 cm (1.05 inches) and the Italian girls 2.6 cm (1.03 inches) shorter than all children; and in weight the boys average 0.43 kilograms (0.94 lbs.) and the girls 0.40 kilograms (0.88 lbs.) lighter than all children tabulated. The amount of deficiency increases with age; in stature Italian boys under one year old are 1.9 cm (0.73 inches) shorter than the general average for this age, while boys 5 years of age are 3.3 cm (1.29 inches) below the corresponding general average. Similarly in regard to weight, the Italian

boys under 1 year of age average 0.34 kilograms (0.76 lbs.), while those 5 years of age average 0.73 kilograms (1.61 lbs.), less than all the children of corresponding ages. In percentages the deficiency in stature and weight appears more uniform than in absolute amounts, increasing, for example, in the case of boys' stature from 2.8 per cent at under one year to 3.0 per cent at 5 years of age; in the case of girls' stature, however, the range of the percentages is greater, increasing from 2.3 per cent at under 1 year to 3.5 per cent at 5 years of age. On an average the percentage of deficiency in stature is 2.9 for both boys and girls, and in weight 3.3 for boys and 3.1 for girls.

The average statures and weights of children of mothers born in Denmark, Sweden, or Norway are, in contrast to those of Italian children, considerably above the general averages. In stature the boys of these nationalities average 1.1 cm (0.42 inches), or 1.2 per cent, and the girls 0.8 cm (0.31 inches), or 0.9 per cent, above the average for all children, while in weight the boys average 0.32 kilograms (0.71 lbs.), or 2.7 per cent, and the girls 0.25 kilograms (0.56 lbs.), or 2.1 per cent above the averages for all children.

The averages for children of mothers born in Germany differ only slightly from those for all children. In stature the German boys are only 0.3 cm (0.12 inches), or 0.3 per cent, and the girls only 0.4 cm (0.17 inches) above the general averages, while in weight the boys are only 0.15 kilograms (0.32 lbs.) and the girls 0.11 kilograms (0.25 lbs.) above the averages for all children. Like the Scandinavian children, the children of German parentage are above the general average for all white children.

As already mentioned, a small number of records, 4,976, was secured for negro children. When the averages for these children are compared with those for white children, slight deficiencies in both stature and weight are shown for the negro group. On an average the negro boys are 1.0 cm (0.40 inches) and the negro girls 0.6 cm (0.22 inches) shorter than white children of the same ages; the negro boys average 0.31 kilograms (0.69 lbs.) and the negro girls 0.25 kilograms (0.55 lbs.) lighter than white boys and girls. In both stature and weight the deficiency appears to be greatest, not only in absolute amount but also in percentage, at ages under 1 year; at five years of age practically no difference in average height and weight is found for either boys or girls between white and negro children.

The second section of the report deals with children who were specially examined for physical defects and, as already stated, the discussion is



based upon results of examinations made by physicians in California and in New York City. In both these areas the physicians who weighed and measured the children were given special instructions to report upon the prevalence of defects. In all 57,977 records relating to children given medical examinations were tabulated.

The figures showing the numbers of children with physical defects have a considerable margin of error, varying with the different defects according to difficulty of diagnosis and to differences in degrees of defects used as standards by the examining physicians.

The defect reported in the largest proportion of cases was enlarged or diseased tonsils. Of the children under 7 years of age 17.7 per cent were reported as having abnormal tonsils. The next most prevalent defect was adenoids with 6.4 per cent. In regard to both these defects no information could be secured as to the degree of defect existing. For most of the children serious defects were doubtless so diagnosed, but some of those who had comparatively minor degrees of defects may have been reported normal.

The prevalence of abnormal tonsils and of adenoids increases with age. Under 1 year a comparatively small proportion of children had either defect. The proportion having diseased or enlarged tonsils increased from 3.7 per cent under 1 year to 15.5 per cent at 1 year and to 25.7 per cent at 2 years, while the proportion having adenoids increased from 1.7 per cent under 1 year to 5.8 per cent at 1 year and to 8.9 per cent at 2 years of age. From two to six years of age the proportions increased slightly to 27.8 per cent having abnormal tonsils and 11.6 per cent having adenoids.

The figures for carious teeth are particularly unsatisfactory since no account could be taken of the number of teeth that were decayed nor of the seriousness of the defect. Only 3.6 per cent of all children under 7 were reported as having carious teeth. The proportion increased rapidly, however, with age, being 14.7 per cent among children 6 years old.

A small proportion, 1.2 per cent, of the children brought for examination were diagnosed as having rachitis. The proportion was largest at 1 year of age when 1.9 per cent were so diagnosed. A small proportion, 1 per cent, was reported as malnourished. A slightly smaller proportion, 0.8 per cent, had heart abnormalities; this percentage increased, however, from 0.2 under 1 year to 3.3 per cent at 6 years of age.

It should be emphasized that all these figures relate only to the children who were brought for examination. Since in California, for example, approximately 6.6 per cent of all the children under 6 years of age in the State were included in the tabulation, it is easily possible that the children with the more serious defects were not brought for examination. A further difficulty in interpreting these percentages, as already suggested, is that diagnoses may not have been made uniformly.

From the data relating to defects a study was made of the correlation between the presence and absence of defects and deficiency in stature and weight. In this connection the points already noted in regard to the probable differences in degrees of defect and difficulties in diagnoses must be borne in mind; errors in diagnosis would tend to reduce the amount of correlation. Furthermore, errors due to failure to include a few children who actually had the defect in the group diagnosed as having the defect, and errors due to including a few normal children in the group diagnosed as having the defect would not invalidate the comparison but would tend merely to lessen the amount of correlation found. In other words, these errors would reduce the size of the deficiency associated with the defect studied.

The method of comparison was to find the average difference between what the children with defects actually weighed and measured and the weights and statures of equal numbers of average children of the same sexes and ages (in months) in the same localities. It should be noted in passing that, in computing the average statures and weights for California and New York City, children diagnosed as having serious defects—including rachitis, malnutrition, and heart abnormalities but not including abnormal tonsils, adenoids or carious teeth,—were omitted. Comparisons are therefore made, for example, of averages for a group of children having rachitis with averages for a group of children none of whom had any serious defects diagnosed and reported.

The average deficiency in stature of 683 children diagnosed as having rachitis was 2.8 cm (1.12 inches), while the average deficiency in weight was 0.86 kilograms (1.90 lbs.). The percentage of deficiency in stature was 3.4 and in weight 7.2. The greatest deficiency in weight was found for children under 1 year of age, approximately 10 per cent.

The number of children diagnosed as malnourished was 591. For these children the average deficiency in stature was nearly 3.4 cm (1.32 inches) and in weight 1.55 kilograms (3.41 lbs.). In both stature and weight the deficiency was greater among malnourished children

than among children diagnosed as having rachitis. Since deficiency in weight or height is commonly used in diagnosing malnutrition, it is not surprising that the figures for malnourished children show deficiency in weight and height.

A total of 444 children was diagnosed as having heart abnormalities. The deficiencies in this group were not great, the deficiency in stature being only 0.4 cm (0.15 inches) and in weight only 0.26 kilograms (0.57 lbs.).

The children reported as having carious teeth numbered 2093. For these children practically no deficiency in height was shown, although a deficiency of 0.06 kg. (0.14 lbs.) was found. But, as already suggested, the diagnoses of carious teeth were particularly unsatisfactory.

The children with adenoids numbered 3,728. No deficiency in stature appeared in these children, but an average deficiency in weight of 0.10 kilograms (0.21 lbs.) was found. On analysis the deficiency in weight appears negligible for children under 3 years of age, but increases for children over 3 to 0.28 kilograms (0.62 lbs.) for children 4 years old.

A total of 10,276 children was reported as having enlarged or diseased tonsils. As in the case of children with adenoids, practically no deficiency in stature was found, while in weight the deficiency averaged 0.05 kilograms (0.12 lbs.). On analysis by age the group under 3 years showed negligible deficiency in weight while the deficiency increased for children over 3 up to 0.21 kilograms (0.46 lbs.) for children 4 years of age.

The fact that this analysis shows small amounts of deficiency in weight among children having carious teeth, adenoids and abnormal tonsils, shows that the averages for the group of children tabulated are not strictly averages for "normal" children. For it will be remembered that children with these defects were not excluded from this group.

From the figures just given, however, an estimate can be made of the effect upon the general averages which the exclusion of children with adenoids, abnormal tonsils and carious teeth would produce. In this way averages for normal children can be estimated, so far as the basic material permits. Under three years of age, as already stated, the correction is negligible; above three years of age the correction increases up to a maximum of plus 0.1 cm (0.05 inches) in height and plus 0.09 kilograms (0.20 lbs.) in weight at 5 years. These corrections should of course be added to the amounts of the deficiencies found for each of the defects discussed if the figures are to represent the differences between average statures and weights of children with defects and averages for



normal children. Even with this correction the averages may be slightly too low for normal children, since the group may have included children with defects which were not noted. On the whole, however, the inclusion of children with minor defects in the group studied seems to have affected the general averages surprisingly little.

Many points of interest could not be treated in the present study since the questions placed upon the record blank were necessarily limited. The discussion suggests, however, many lines of inquiry worthy of further study and accumulation of additional material.

## A REMARKABLE HUMAN LOWER JAW FROM PERU

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Among the specimens gathered by the Yale Peruvian Expeditions of 1914 and 1915, one human lower jaw belongs to a type so distinct as to demand more than a passing notice. The caves explored by the expeditions were all in the Highlands to the northwest of Cuzco. The most fruitful single site was the big cave near the ruins of Paucarcancha, at an elevation of 10,000 feet and [near the junction of the Rio Quesca with the Rio Pampacahuana.

From this one cave were gathered bones belonging to at least 200 individuals. Among the bones, crania and femora predominate. The crania number 192, counting those in a fragmentary condition and those of children. Very few of the crania were accompanied by their respective lower jaws. On the other hand there are scores of lower jaws that cannot be fitted to any of the crania. Among the odd lot of lower jaws was the one in question, which presumably belonged to a male. For the sake of comparison this lower jaw has been photographed with a male lower jaw of the usual size and shape from a cave at Huaracundo, about midway between Cuzco and Paucarcancha, as seen in figures 1 and 2, the lower jaw from Paucarcancha being the one at the bottom in each figure.

Although very small and narrow, the lower jaw is of robust build. The bicondylar breadth (10 cm.) is too small for even the smallest cranium brought back by the Expeditions, and the smallest cranium has a capacity of only 1,020 ccm. On the other hand the breadth of the ascending ramus (3.7 cm.) is as large as that of any other lower jaw in the entire collection from the highlands of Peru. In fact only three other lower jaws, all of them belonging to males, approach it in this respect. The ascending ramus is remarkable also for the straightness of its anterior margin.

In the collection taken as a whole, the coronoid process is almost without exception higher than the condyloid. In this specimen the reverse is true and the sigmoid notch is very shallow. The bigonial diameter



PLATE I



Upper: Lower Jaw of Paucarcancha  
Lower: Lower Jaw of Huaracundo

PLATE II



Upper: Lower Jaw of Huaracundo  
Lower: Lower Jaw of Paucarcancha

measures only 7.1 cm. The thickness of the horizontal ramus at the level of the second molars is exaggerated (1.8 cm.) on account of the prominences immediately in front of the anterior limits of the masseter muscles. The spina mentalis is but feebly developed.

There are sixteen teeth, all of which were in situ at the time of decease and only one of which shows any sign of decay. The third molars are well developed and only slightly worn. The wearing of the first molars is much more pronounced, pointing to an age for the individual of some forty years.

The nearest approach to this lower jaw is found in another odd lot of specimens, also from Paucarcancha. It, however, lacks the ascending ramus. In all respects it is less robust than the previous example and probably belongs to a female of the same or a kindred type.

Had such a lower jaw as the one here figured been found in some ancient cave or rock shelter, or in diluvial deposits, it would in all probability have been hailed as the fitting representative of a new species of the genus *Homo*.



## OBSERVATIONS ON AGE CHANGES IN THE SCAPULA

### A PRELIMINARY NOTE

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In 1920 while further studying scapular character variations, through the courtesy of Prof. T. Wingate Todd (Hamann Museum, Department of Anatomy, Western Reserve University), the writer became impressed with a series of changes in the scapula, which appears to be intimately associated with advancing years after maturity of the bone. The human skeletal material in the Hamann Museum is exceedingly valuable for the investigation of bone-age changes in general. It comprises at the present time approximately 750 complete skeletons ranging from birth to 88 years, of known age, sex and stock, and it is growing at the rate of 100 such skeletons a year. Data on age, sex and stock are accessible in all, and data on clinical history, as well as clinical or anatomical causes of death, are accessible in a large number of these complete skeletons.

The scapula is a bone peculiarly adapted to the study of skeletal age changes in any age period. In the first place, its several centers for ossification, uniting in various parts of the bone in sequence at different ages and finally producing an adult scapula in every detail by approximately the 22nd year of life, give to this bone peculiar importance in estimating the bone age of skeletal material during growth periods up to maturity. In the second place, its numerous anatomical and architectural characters, (each of which shows wide variation) its thickened borders limiting its greatly thinned body, its angles, its spine and acromion, its coracoid process, its glenoid, its clavicular facet, its relative freedom from weight influences, its relation to a number of muscles and its peculiar vascular supply, all combine to give to the scapula definite values in studies of skeletal age changes during advancing age periods after the 25th year of life. Regardless of whatever values the scapula may disclose through further investigations, we must not forget that it is only one of many skeletal features showing the ravages of time. Therefore, its worth as a "time-marker" should only be evaluated in connection with other bones and when possible with other tissues.

In a survey of age changes shown in scapulae, it is found that several important features must be investigated and discussed. The relation of the changes identified with age to the type of scapula from birth onward, to certain scapular variations, to human stock, to sex and possibly to disease, must each, in due course, receive attention. The reasons for considering age changes in relation to possible stock, sex and disease differences are obvious, but one would ordinarily suppose that no valid reasons could be given for considering age changes in relation to scapular variations and types, yet such relations are probably equally important. In this connection, attention is called to the writer's communication on "The Types of Scapulae" (*AMERICAN JOURNAL OF PHYSICAL ANTHROPOLOGY*, Vol. IV., No. 2, p. 111.) in which is pointed out certain morphological differences present in the convex, straight and concave types. The writer has secured some data in reference to age changes on 589 pairs of scapulae, embracing convex, straight and concave types from white and negroid stock in the Hamann Museum, and he has more intimately studied the age changes in 139 pairs of scapulae of the convex type from the white males, ranging in years from 18 to 88. It seems advisable thus early in the investigations to define and describe in outline some of the gross features in the scapula which show relation to age after maturity.

#### SCAPULAR STRUCTURES INVOLVED IN AGE CHANGE PROCESSES

Age changes in scapulae appear to be manifestations of two diametrically opposed processes: the one an ossification process; the other an atrophic process; both occurring after maturity of the bone. The chief structures which show age changes attributed to an ossification process with advancing years are: (1) The articular cartilage in its relation to the bony glenoid margins and possibly also, in the old, of the Labrum glenoidale in its relation to the articular cartilage; (2) The cartilaginous structure covering the margin and surface of the clavicular facet, and possibly of the inter-articular cartilage and joint capsule; (3) The under surface and tip of the acromion in their relation to the coraco-acromial ligament, to the subacromial bursa and to other contiguous structures; (4) The trapezial smooth surface at the base of the spine, and possibly its relation to the trapezial bursa wall; and (5) The cristae in their relation to subscapular intermuscular septa.

The structures which show age changes attributed to an atrophic process discernible mainly in the thinned body of the bone are:

(1) Diminution and eventually loss of surface vascularity; (2) Diminution and alteration in deep vascularity; (3) The occurrence of localized areas of bone atrophy; (4) A buckling or pleating of the thinned body mainly of its dorsal surface above and below the spine, and (5) Distortion of the thinned body mainly below the spine.

Age changes attributed to ossification are equally discernible in scapulae whether fixed (i.e., embalmed) or unfixed. If, however, the bones have been macerated without previous fixation (embalming), the picture of the changes in superficial and deep vascularity is altered, but the other features incident to an atrophic process are readily discernible in fixed and unfixed bones. With the protocols of scapulae to be submitted in the final paper on changes attributed to age the specific differences depending upon fixation and non-fixation will be pointed out. The following outline of definitions and descriptions of gross age-change features is based solely on bones from bodies adequately "fixed" for dissecting purposes.

#### AGE CHANGES ATTRIBUTED TO AN OSSIFICATION PROCESS AFTER MATURITY

I. Glenoid lipping implies any degree of ossification, in whole or in part, of what appears primarily to have been the articular cartilage in its relation to the glenoid margins or to the immediately adjacent surfaces. Depending upon the bone age of the individual, the lipping may involve the ventral, inferior, dorsal or superior margin and usually in the order named or it may involve the entire marginal surface. When the entire glenoid marginal surface shows lipping it may be rather uniform or it may be distinctly irregular. The lipping usually begins, in the early thirties at the notch or depression which is located at the junction of the upper and middle thirds of the ventral glenoid margin (Pl. I., No. 535). The lipping may be slight, moderate or marked. When it involves the entire marginal surface, it may be flaring, broad at the top thus greatly increasing all original glenoid diameters (Pl. I, No. 551) or it may have nearly vertical walls, increasing the depth of the original bony glenoid cavity (Pl. I, No. 535). In some bones especially those with flaring glenoid margins, the original bony margins seem to be encased, as it were, in new bone (Pl. I, Fig. 551). Rarely the lipping may invade, in part, the articular cartilage near any portion of the glenoid margin. No difficulty should be experienced in recognizing the lipping, if one remembers that at maturity the bony glenoid margins are nowhere roughened, sharpened or elevated. The margins at this



period are relatively smooth and everywhere more or less rounded; less so, however, at the ventral margin than at any other point. When lipping is present, it is easily detected by vision and touch, and when extensive also by transmitted light. Holding a margin of a glenoid in front of a window or an electric-light bulb, one often notes that the ossified cartilage is translucent, and there is often a definite line of demarcation between the lipping and the former bony margin. Whether in pre-senile and senile scapulae the Labrum glenoidale becomes involved, can be determined only by further study.<sup>1</sup>

II. Clavicular facet lipping implies ossification of the cartilage covering the margins and surface of this facet and possibly also of the inter-articular cartilage and joint capsule. When lipping is present, it is seldom uniform, and in some cases it involves the entire margin (Pl. II, No. 535 lower). In the old and relatively old, there is often a marked deformity of this facet, not only of its margins but likewise of its articular surface. When such exists, it is strongly suggestive of a former osteo-arthritic process. Nevertheless, the deformity has been found thus far only when associated with other definite scapular age changes.

III. Acromial under-surface and tip ossification implies the presence of an elevated *plaque* of bone varying in form, size and thickness, situated on the under-surface of the acromion within the area bounded by the outer margin of the acromion and a mesially curved line beginning at the metacromion and ending just lateral to the clavicular facet (Pl. II, Nos. 806, 535). It often prolongs the acromion tip from 2 mm. to 8 or more, and whenever large, usually extends beyond the outer deltoid margin (Pl. II, Nos. 806, 535). It may be elevated 2 mm. or more above the under-surface of the acromion. It is often oval or nearly so, and when extensive, its long axis usually parallels that of the acromion (Pl. II, Nos. 806, 535). Its long axis varies from 5 to 35 mm. and its transverse axis from 4 to 25 mm. When it is prolonged beyond the tip, it parallels

<sup>1</sup> R. Fick (Bardeleben, Handbuch der Anatomie, Gelenke I p. 169) states that the cartilage covering the middle of the glenoid cavity is 1.3 mm. thick, it increases in thickness toward the margins and at the inferior margin it is  $3\frac{1}{2}$  mm., at superior ventral and dorsal margins  $2\frac{1}{2}$  mm. thick. My own measurements of marked vertical lipping of the entire glenoid margin correspond closely with Fick's measurements of the cartilage covering the bony glenoid margins. While the Labrum glenoidale is in intimate relation with the greater portion of that part of the articular cartilage covering the bony glenoid margin, it, however, appears that the structure primarily involved in the lipping is the articular cartilage covering the glenoid margin of the adult bone.

the general direction of the coraco-acromial ligament (Pl. I, No. 535 and Pl. II, No. 535). Its under-surface is relatively smooth and often concave. Its dorsal surface, when it extends beyond the tip, is usually convex, and the tip of the plaque is often serrated or digitated (Pl. II, No. 535 lower). Its extension of the acromion tip and its direction are strongly suggestive of ossification of the acromial portion of the coraco-acromial ligament in its relation to the tip and under-surface of the acromion. But the limitation of this plaque to the under-surface of the acromion in some cases and its variation in form, size and thickness strongly suggest the involvement by ossification of the subacromial bursal wall and possibly of other contiguous structures.<sup>2</sup>

V. Trapezial smooth surface ossification is defined as granular or scale-like proliferation involving the triangular smooth surface at the base of the scapular spine. When such exists this surface becomes uneven and roughened. It is easily discernible by sight and touch; often symmetrical in degree and form, although it may be confined to one surface (right or left) alone.

VI. Cristae ossification implies relative increase in cross-section and roughening of their surfaces, especially of their apices (Pl. III, No. 172 and Pl. IV, 285 top). In the new-born, the cristae are seldom even indicated on the bone. They are relatively small at the 12th year, and become more definite in succeeding years to maturity, at which period they are usually well marked, but their apices at this period are relatively smooth. Even at maturity and afterwards they vary greatly

<sup>2</sup> This plaque has been noted in every considerable collection of scapulae, representing various human stocks thus far examined by me. I have also found it in other primates, i.e., gorilla, orang and chimpanzee. Until the present study I had interpreted it as a rather frequent morphologic variation. No reference to it as yet has been found in the literature. The evidence thus far secured which seems to justify the presumption of an age factor in its interpretation is as follows: (1) that it is not a vestigial structure either in an ontogenetic or in a phylogenetic sense; hence it is a structure devoid of former or present function; (2) that when of considerable size, as in No. 535, Pl. II, it may interfere, more or less, with shoulder-girdle function; (3) that it is invariably associated with some of the age changes defined and described in the text; (4) that neither in man nor in other primates has it thus far been found in young and relatively young, but invariably in old and relatively old bones; and (5) that it is indicated as early as the 30th year in human scapulae, increasing in size and frequency of occurrence in succeeding age periods, although it may be either rudimentary or absent even in senile bones. The precise structure or structures involved in the genesis of the plaque; what relation, if any, its presence may bear to pathological processes in general, aside from those incident to age, are problems for further investigation.

in number, length and cross-section. They often show marked asymmetry in these particulars right with left in age periods before, at, and after maturity. Moreover, variation in number, size and symmetry of the cristae appears to be in no way dependent upon right handedness, left handedness or muscular development of the individual. Large and strong bones may show rudimentary and markedly asymmetrical cristae; whereas small and weak bones may show large and nearly symmetrical cristae. Whatever their degree of development and symmetry at maturity may have been, they appear to become broader at their bases, more prominent and their apices more roughened or serrated with advancing years. These features, particularly the degree of roughness of the apices, are taken into account in estimating the bone age of scapulae after maturity.

AGE CHANGES ATTRIBUTED TO AN ATROPHIC PROCESS AFTER  
MATURITY

I. Surface vascularity is defined as visibility to the naked eye of the vessels which seemingly lie just within the outer layer of compact tissue about the dorsal and ventral surface of the body and the bridge of the spine of the scapula. Surface vessels in properly "fixed" specimens are more or less numerous during the developmental periods from birth to maturity, but diminish in visibility and finally disappear as age advances.

II. Deep vascularity is defined as visibility of vessels to the naked eye as may be noted in the body of a bone to transillumination, as from a window or electric-light bulb. Photographic transillumination of a pair of scapulae from an individual aged 13 years is shown in Pl. V, No. 633. It is noted that the vascularity is poorest in the normally thinned areas of the body, namely, above the spine, just below the spine, along the axillary border and extending along the vertebral border in the inferior-angle region. It is richer along the vertebral border above the inferior-angle region, in the area near the center of the body below the spine, and still richer in the areas adjacent to the spine above and below it, and along the margins of the normally thinned areas. Deep vascularity is richest, as is surface vascularity, in periods of greatest growth, as at pubescence, but diminishes in succeeding life periods. It becomes less in the early twenties, as shown in Pl. V, No. 680 which is from a photograph of deep vascularity by transillumination in a pair of bones at 23 years for comparison with Nos. 633, 115 and 285. In advancing years after maturity of the scapula, deep vascularity continues to be-



come less and less visible, but in no period in bones thus far examined does it wholly disappear. In Pl. VI, No. 115 showing transillumination of a pair of scapulae of a white male, age 88 years, small vessels were still visible just above and below the spine, but were most marked in the glenoid region below the spine. Deep vascularity may be diffuse, a characteristic of bones to trans-illumination prior to, at, or somewhat after maturity (Pl. V, Nos. 633 and 680). In bones after maturity alteration in diffuseness of deep vascularity, when present, is called patchy, and the degree of patchiness may be slight, moderate or marked (Pl. IV, No. 285 and Pl. VI, No. 115). With advancing years the size of vessels and their visibility to the naked eye becomes appreciably less, disappearing first from the normally thinnest, relatively most poorly vascularized areas, but persisting in number and degree in the well vascularized areas of the bone, as along the root of the spine, above and below it, and especially in the glenoid and vertebral-border regions just below the spine. Even in the scapulae of No. 115 a few small vessels are still discernible (not shown in the photograph) in the glenoid and vertebral-border regions below the spine and in the persistent cancellous tissue near the middle of the body below the spine. The transition from diffuse to patchy vascularity and its degree of patchiness appears to be intimately connected with the feature next to be described, which is to me the most striking scapular age feature connected with advancing years, namely, the presence of what are here designated *atrophic spots*.

III. Atrophic spots may be defined as localized, discrete or coalescing areas of bone atrophy. They are discernible to the naked eye in the body of the scapula by direct- and trans-illumination, and to palpation. I have already referred to the diffuse nature of deep vascularity prior to, at, and somewhat after maturity and to the occurrence of varying degrees in patchiness as indications of advancing years. Atrophic spots do not occur without some degree of patchiness in vascularity; hence slight patchiness is probably the forerunner of these spots, and may be construed as an early manifestation of the atrophic process which seems to underlie them. In giving an outline description of atrophic spots, let me here recall the original observations on the scapulae from skeleton No. 285 of a white male age 45, dying of pulmonary tuberculosis (Pl. IV, No. 285). While examining the borders for variations and translucency, it was noted that the bodies of this pair of "convex" scapulae appeared to be *patchy*, spotted, "moth-eaten" and particularly so in the thinned areas above and below the spine. When viewed with direct

light some of the spots were found to be depressed (excavated) below the level of the adjacent surface of the bone, thus sharply delimiting them from surrounding tissue (Pl. IV, No. 285 top). Those thus depressed below the surface were thin to palpation, almost as thin as parchment. To trans-illumination they were pale and deficient in pigment in part, and the paler areas were pearly, granular, amorphous, in appearance not unlike "dissolving sugar in weak tea." The more pigmented areas within such a spot were slightly thicker and less translucent, and connected with its adjacent border by a bridge or bridges of persistent cancellous tissue. To low power magnification (10 diameters), the definitely "granular" portion of such a spot was found to be poorly vascularized; only a few minute vessels could be seen; whereas, in the denser interior and connecting bridges, the vessels were larger and more numerous. Examination of a number of scapulae from individuals under 45 years disclosed either absence, smallness or infrequency of these spots; whereas, the scapulae of a number of individuals beyond 45 years usually disclosed them in greater number, size and degree. It was also found that there was an intimate association between the number, size and degree of "spots" and the patchiness in deep vascularity. All these findings were true in a general way, irrespective of the cause of death, though it was occasionally found on consulting the records, that in individuals who had died from exhausting diseases (tuberculosis, syphilis, cancer, etc., etc.) the scapular bone age was somewhat greater than the chronological age. The scapular bone age of skeleton 285 (Pl. IV) was at least 7 years greater than the chronological age, and Dr. Todd, in considering bone age features of other bones of this skeleton found some of them to be beyond the chronological age. Following these initial observations other scapular features herein defined and described were found to be associated with advancing years. Varying numbers and degrees of these features are invariably present in scapulae disclosing atrophic spots. Moreover, further observations have shown that similar "spots" are present in scapulae of other mammals whose skeletons show senile changes, and they are also present in senile thin bones generally, analogous to human shoulder blades in their proportions of cancellous and compact tissues. I must here emphasize the fact that not every area of a scapula showing localized translucency, whatever the size or degree, is an atrophic spot. In addition to increased translucency there must be a localized alteration in the vascularity and in the structure of the bone. In general it may be said that the "atrophic spots" vary greatly in size (3 mm. to 10 or more) and

in the early stages have irregular patterns, but in later stages tend to become ovoid or circular. They are discrete in the early stage, but in the later stages of development they coalesce, and in some senile bones these coalescing atrophic spots involve the greater portion of the body. In such bones, the bodies become very thin in the greater part and the cancellous tissue in the thinner areas of the bones practically disappears. Even the cancellous tissue adjacent to the borders of the bone is often invaded by spots. Finally in very senile bones and in those whose bodies are normally very thin, yet showing senile changes, oval defects varying in diameter from 2 to 5 mm. occur in the extremely thin areas of the spots. As may well be imagined, because of parchment-like thinness of advanced atrophic spots, they often show irregular fragmentation. The round or oval defects in atrophic spots must, of course, be differentiated from congenital membranous defects (very rare variations) and pseudo-membranous defects often found in scapulae following body fracture. True and pseudo-membranous defects are differentiated from atrophic spots by their larger size, thicker margins and by the absence of alterations in vascularity and in bone structure.

IV. & V. Buckling or Pleating and Distortion may best have a common description (Pl. III, Nos. 427 and 172). Each of these age features appears to depend primarily upon altered vascularity leading to irregular bone absorption (atrophy) especially of the cancellous tissue. The absorption, mainly of this tissue, seems to underlie the alterations in contour of body surfaces and distortion of the entire thickness of the body of the bone. Buckling or pleating implies alteration in form of the originally relatively smooth body surface, and mainly of its dorsal surface. When present the body is no longer smooth, but it is thrown into folds, coarse wrinkles or pleats. It is usually present in some degree in the early thirties, and often makes its appearance as a single elevated buckle, wrinkle or pleat running transversely to the long scapular axis in the superior-angle region (see Pl. III, No. 427 left). At about the same age period less definite pleats make their appearance about the dorsal surface of the body below the spine, and parallel in a general way the direction of the cristae. Buckling or pleating is seldom a very prominent age feature if the body of the bone is thick. It is, however, a frequent age feature in most bones, and it increases in degree usually with succeeding age periods after 30.

Distortion implies deformity or warping of the entire thickness of the body of the scapula occurring mainly below the spine (see Pl. III, No. 172). It is seldom found in any degree prior to the 40th year. It is



never marked in those exceptional bones having very thick bodies. Buckling or pleating and distortion in fixed and unfixed scapulae are present, whatever the form of maceration may have been. Moreover these age features are usually present in recently dissected scapulae, provided their possessors have attained sufficient age.

#### GENERAL CONSIDERATIONS

The foregoing outline of the gross features related to age in scapulae after maturity is by no means comprehensive. Those defined and described are the most constant, and are, therefore, the most dependable in estimating the bone age of a scapula. Among the least constant scapular age changes, yet not without value, may be mentioned:—the unusual roughening of certain muscle surfaces, processes and lines (Teres major and minor, Infraspinatus, Deltoid, Trapezius, the field on the vertebral border in the inferior-angle region occupied by the lower fibers of Rhomboideus major in their relations to the fibers of the Serratus anterior, and of the infra-glenoid process); increased translucency of some or all of the borders, the bridge of the spine, the acromion, glenoid and coracoid; the gradual absorption of the relatively thick, often highly pigmented cancellous tissue along the cristae and in the several border regions; the extreme lightness of old bones when compared with young ones of approximately similar dimensions; and the occurrence of atrophic spots in the spine-bridge window of those bones with normally thin windows.<sup>3</sup>

Any one of the above described features, except alterations in deep vascularity, may be absent at an age period in which one might expect to find it. Again, the scapula may be older in bone age than in chronological age, or it may be younger than the chronological age of a given individual. Todd has emphasized these findings in his studies of the Pubic bone.<sup>4</sup> Moreover, everyday observations show that among individuals of the same stock and general environment, some are older and others are younger than their years, as we judge them by their

<sup>3</sup> The increasing translucency of the thicker, as well as of the thinner, portions of the scapula and the decreasing weight usually step by step with advancing years leads one to infer that the atrophic process is not limited to the normally thinner portions of the bone. Whether this inference be founded in fact, and if so, how extensive the atrophic process may be, are problems for further investigation. An x-ray plate of the same scapulae shown in pl. VI from skeleton 115 (white male, 88) revealed definite areas of absorption (atrophy) in the left bone, in the interior of the inferior-angle region.

<sup>4</sup> Todd (T. Wingate), Age Changes in the Pubic Bone. *Am. J. Phys. Anthropol.* 1920, III, No. 3, 286; also 1921, IV, No. 1, 1 *et seq.*

general appearance and reactions. Again, exhausting diseases may advance the bone age of a given individual just as it may advance the age of other tissues; hence we should not be surprised to find, indeed, we should expect to find the registration of advanced skeletal metamorphosis in some cases. But these findings are merely the exceptions to the general rule. Just as Todd has shown in his studies on the Pubic bone, so do my studies thus far on the scapula show that in most individuals there is a close agreement between scapular bone age and chronological age. How close this agreement may be, and what are the usual combinations of scapular features identifiable with each age period await further investigation.

#### SUMMARY

(1) The scapula is peculiarly adapted to the study of skeletal age changes in any post-natal period, but its worth should be evaluated in connection with age changes in other bones.

(2) The age changes in the scapula outlined in this note appear to depend upon two diametrically opposed processes; the one, an ossification process; the other, an atrophic process, and both occur after maturity of the bone.

(3) Not all of the structures involved in the ossification process are known at this time. Further investigations are necessary to identify them. Moreover, histological investigations are necessary to determine more closely both the nature and the extent of the ossification and atrophic processes.

(4) The scapular changes related to age must be further investigated in reference to the type of scapula, to scapular variations, to human stock, to sex and to disease.

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Grateful acknowledgment is due Dr. Todd for the encouragement, the criticism and the many courtesies extended while working in the Hamann Museum, and thanks are due to Miss Harvey for many photographs some of which are used as illustrations.

NO. 535,

PL. I.

A view of scapulae No. 535 showing the deltoid margins of the plaques in relief and their general direction, paralleling that of the coraco-acromial ligament. Note the rather marked vertical glenoid lipping, also practical obliteration of glenoid notch by lipping on the left bone.

- NO. 551,  
PL. I. Marked flaring lipping of entire glenoid margin with obliteration of glenoid notch L. and R. Note the encasing effect of lipping upon original glenoid margin, especially ventrally right and dorso-superiorly left. (White male, 60 years.)
- NO. 806,  
PL. II. An elevated, oval plaque of ossification (left more than right) of the acromial undersurface, without tip involvement. The plaque extends slightly beyond and parallels the deltoid margin. (White male, 35 years.)
- NO. 535,  
PL. II. (mid) Unusually extensive oval, cup-shaped, elevated and rather symmetrical plaques involving undersurface of acromion and tip in the ossification. Each plaque measures approximately 22 x 35 mm., prolonging the original acromion tip 17 mm. and extending beyond the deltoid margin 5 mm. The distance between the original acromial tip and coracoid is reduced approx. 13 mm. Thickness of plaques at acromial tip is approx. 6 mm. (White male, 50 years.)
- NO. 535,  
PL. II. (low) Another view of 535. Note the serrated margins of the plaques and the reduced distance of the prolonged acromial tips from coracoids and the relation of the plaques to the greatly enlarged, markedly lipped and roughened clavicular facets.
- NO. 427,  
PL. III. A dorsal view showing atrophic spots, buckling or pleating and distortion. Note particularly the transverse pleat on body of left bone above spine beneath which is a circular, excavated fragmenting atrophic spot. (White male, 65 years.)
- NO. 172,  
PL. III. A ventral view showing prominence of cristae and roughening of their surfaces, also pleating and distortion of body. Cause of death—gastric carcinoma. Note in sub-scapular fossa on left bone a small tumor, possibly metastatic. Bone age about 10 years greater than chronological age. (White male, 50 years.)
- NO. 285,  
PL. IV. (top) A ventral view of scapulae showing advanced discrete, coalescing and excavated atrophic spots in bodies below spine; more definite in right bone. Cause of death pulmonary tuberculosis. Bone age about 7 years greater than chronological age. (White male, 45 years.)
- NO. 285,  
PL. IV.  
bottom) A transillumination view of scapulae from dorsal aspect. Note general patchiness and atrophic spots in whiter areas.
- NO. 633,  
PL. V. Deep vascularity distribution shown in transillumination as described in the text. (Colored, female, 13 years.)
- NO. 680,  
PL. V. Deep vascularity by transillumination. Note diminution in deep vascularity in comparison with Fig. 633. (White male, 23 years.)



NO. 115,  
PL. VI.

Almost complete disappearance of deep vascularity to transillumination for comparison with Nos. 633 and 680, Pl. V. Note distinct patches of persistent cancellous tissue near middle of bodies below spine. (White male, 88 years.)<sup>5</sup>

<sup>5</sup> Nos. 633, 680, 285 and 115 from transillumination photographs require a word of explanation. The technical details were as follows: The bones were placed on the transparent object-plate dorsal surfaces uppermost as in No. 427, Pl. III, and plasticine was then used to exclude the light from around their margins, the source of light being a 60 Watt mazda beneath object plate. The camera was centered above the bones and focused. Obviously only the more or less translucent areas can be shown with such technique; hence the absence of spines, acromions, borders, glenoids, etc. in figures, but borders and spines are outlined for orientation. The thinner portions are the more translucent and are shown in the lighter areas; whereas, the thicker or denser, less translucent portions, are the darker areas in figures. The positions of the spines and cristae and of the denser areas of the bodies adjacent to them shade down to black. A stronger illuminant fogs the plate and the exposure in radiography is difficult to time so that the radiographic results are too poor for adequate reproduction (personal communication from Miss Harvey).



PLATE I





PLATE II

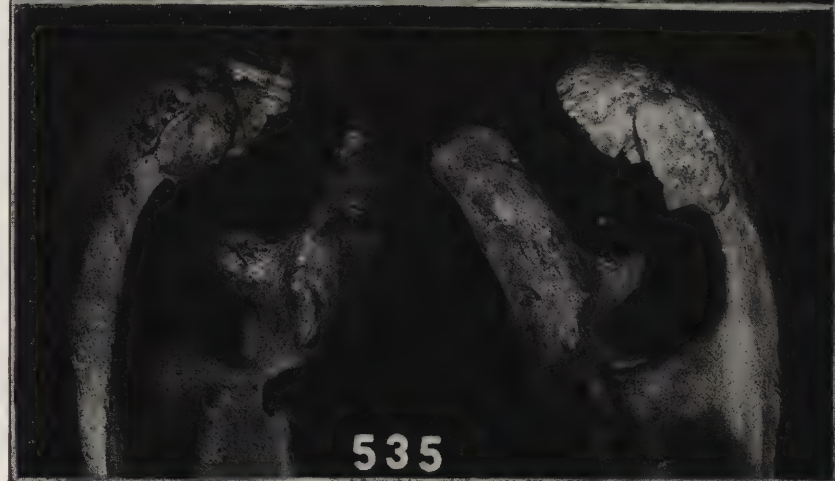


PLATE III





PLATE IV

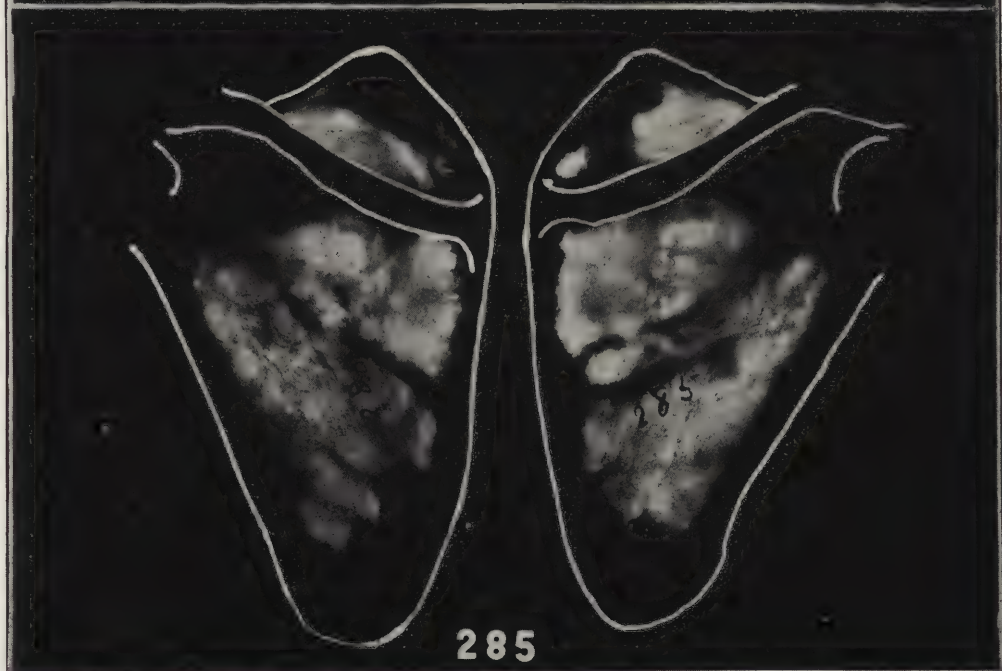




PLATE V

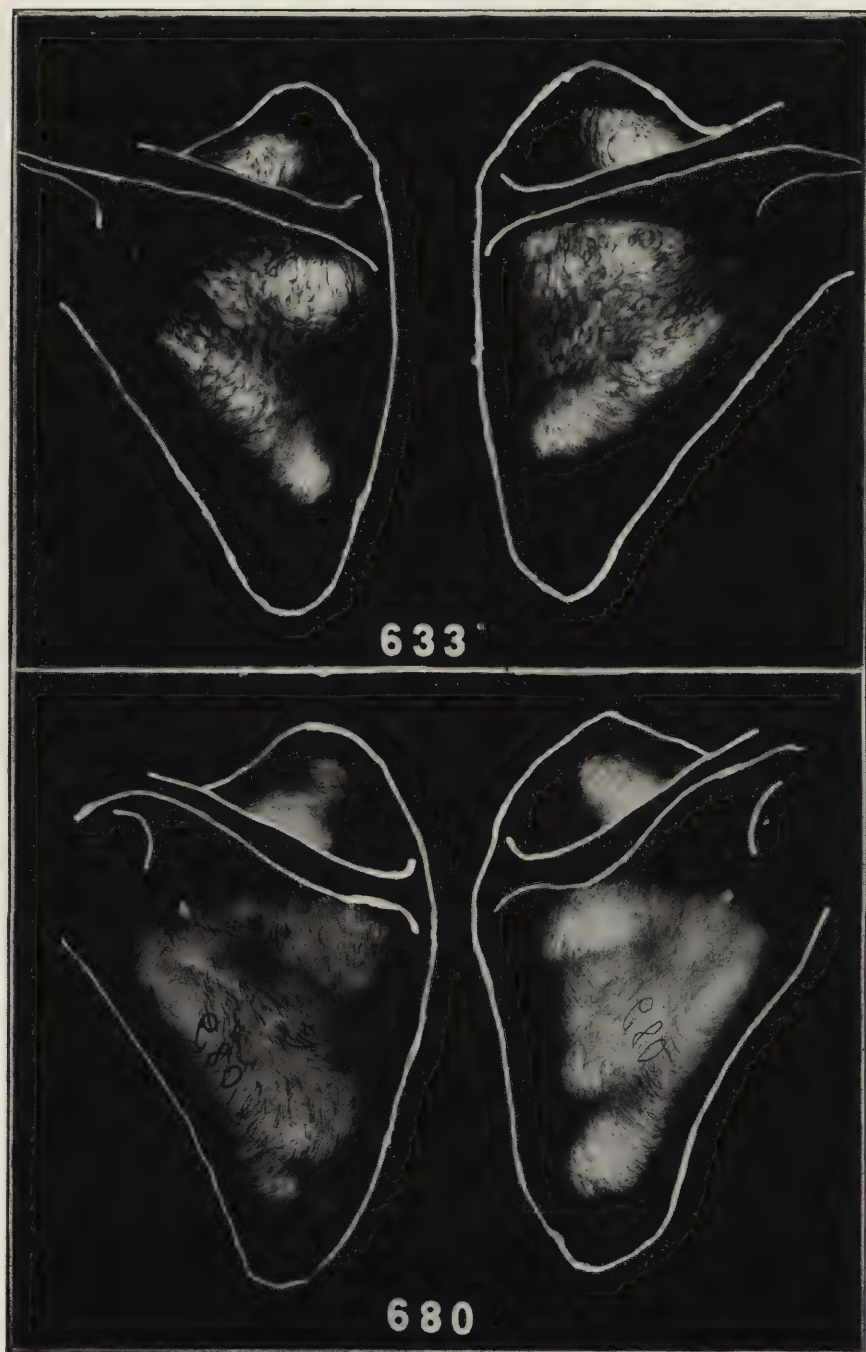
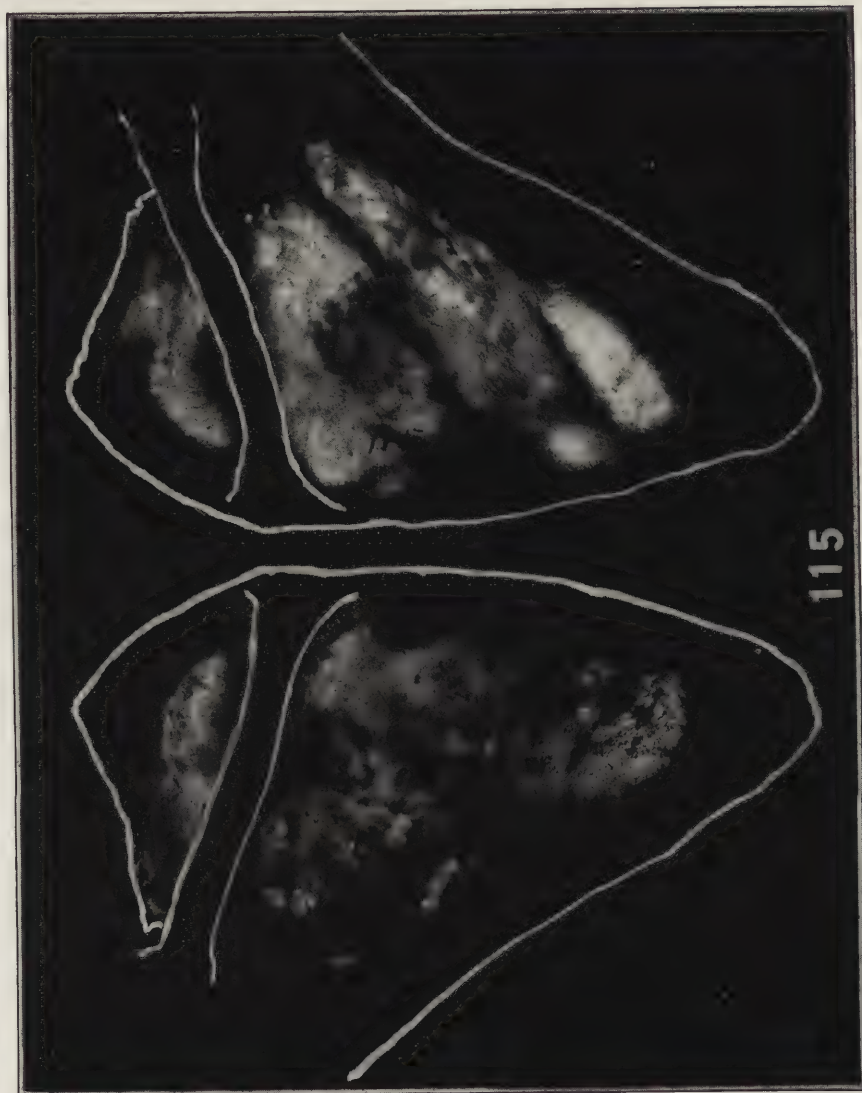


PLATE VI



## THE INCIDENCE OF THE SUPRACONDYLOID PROCESS IN THE INSANE

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Since Tiedemann's discovery of the supracondyloid process in man (1822) a large number of cases have been reported and an extensive literature has grown up concerning this extraordinary variation. Much of it deals with the question of its phylogenesis.

Tiedemann himself, Virchow and some others, regarded the supracondyloid process in the light of a pathological exostosis. Poulet ('83), a surgeon, even went so far as to chisel away one process in the belief that in one case the process had been responsible for a paralysis. The influence of Virchow's dictum especially, as to the pathological nature of the process, prevailed for some years after the anatomists were in possession of the facts revealed by comparative studies and Struthers had demonstrated stages of its normal development in the cat ('83). No one today regards the supracondyloid process as a pathological exostosis.

As to the ontogenesis of the process very little is known. Its presence in children has been observed by Struthers, Testut, Nicolas and probably others. Terry (unreported case) has found a well defined spur at the site of the process in the humerus of a new born infant. Cunningham ('99) reported a case of a still-born infant with large processes on either humerus fully ossified from the base to the tip. He thinks that the process is ossified along with the diaphysis of the humerus and from the same center. It was shown by Struthers ('63) that no theory of muscularity explains the presence of the process, for it was found indiscriminately in male or female, robust or slender, young or old, on the right arm or left, all in such proportions that it was evident that the muscularity or the activity of the individual had nothing to do with its presence. Cunningham's observation conclusively confirms this previous observation, since if the process is present at birth, muscularity obviously has little to do with its origin. Testut ('89) later confirmed Struther's observation that the process occurred equally in both sexes,



and about equally on either humerus. In 1863, Struthers published an account of the later development of the supracondyloid foramen and process in the cat, showing that the latter is at first a bony spur of the humerus united by a fibrous band with the medial epicondyle. Investigation now in progress by Dr. Terry on the early development of the process shows a large participation of the medial epicondyle in the formation of the bridge which completes the supracondyloid foramen.

Struthers ('73) was the first to point out that there is probably an hereditary factor in the transmission of the process from parent to child. In a family reported by Terry ('21) the process was present bilaterally in one brother and unilaterally in one sister.

In recent years evidence has been brought forward (Nicolas, Valenti, Ferdinando) which is supposed to indicate a correlation between the anomaly and mental defect of the individual. This belief has its basis in the apparently greater incidence of the supracondyloid process among the insane and criminal classes than in normal persons. Such a correlation is very far from being established. It is the object of this study of the incidence of the supracondyloid process in the insane to attempt to test the question of such a possible relation. Since there is the possibility of a source of error in the small series studied in the previous investigation it is proposed to inquire into the frequency of the variation in a larger group of the insane than has hitherto been considered.

#### I. INCIDENCE

That it is not an uncommon occurrence to find a supracondyloid process is well demonstrated by the literature of the subject. However, there is considerable unexplained discrepancy among the various reports of its frequency. Struthers ('73) estimated that the supracondyloid process presented itself in 2.0 per cent of the cases. He bases this figure on the occurrence of one process in fifty cadavers dissected in his laboratory. However, he does not think it can be recognized in 2.0 per cent of individuals by palpation in the living subject. Gruber ('59) reports its frequency as 2.7 per cent. Romiti (quoted by Ferdinando) reports 2.71 per cent; and Ferdinando 1.63 per cent. Nicolas ('90) examined 168 supposedly normal individuals for the process and did not find it present in any of them. Testut ('89) found in 929 cadavers the process 9 times, or slightly less than 1 per cent; there were 8 individuals having the variation, i.e., 0.8+ per cent, and 0.6 per cent of processes exclusive of tubercles. Poirier and Charpy ('11) report 2 per cent. Hrdlička (quoted by Terry) found the process to be present in 1 per cent of the

humeri of adult whites from the anatomical laboratory of the College of Physicians and Surgeons, New York. In this study of the prepared bones the supracondyloid variation was classified as: a roughness, ridge, tubercle or process. The latter is an elevation of not less than 3 mm. The incidence was calculated upon the number of processes in the total number of humeri. Professor Terry ('21) found in 1000 dispensary patients 7 individuals with the process; an incidence of 0.7 per cent; an incidence of 0.878 per cent represented the frequency of palpable processes in the whites in the group, this figure rising to 1.16 per cent if only adult whites are counted.

## II. OBSERVATIONS ON THE INSANE AND CRIMINALS IN THE LITERATURE

Nicolas ('98) also made a study of the insane and in 115 individuals found the process present six times, three times bilaterally, making nine processes in all; the incidence given is 7.8 per cent. Valenti ('96) found the process three times, twice in criminals and once in an insane woman; but he makes no estimate of its incidence in the mentally defective. Ferdinando ('99) reports the incidence in Italian criminals as high as 11.29 per cent. He found the process 7 times in 122 humeri belonging to 63 individuals. In one instance its occurrence was bilateral. The only one of Terry's cases having a frankly neuropathic diagnosis was a woman whose brother and sister also showed the process.

*Discussion of Incidence in the Normal Group.* Let us now examine the figures which have been given to represent the incidence in the groups at large. The results of Gruber and Struthers will not be considered since their method of obtaining them was not clearly shown. Testut ('89), Hrdlička (quoted by Terry), and Terry ('21) have described their methods of determining their figures. Hrdlička has defined a "process" in this particular variation as a projection not less than 3 mm. in height. Elevations (excepting linear) under this minimum length he classifies as tubercles. Terry's work shows that this minimum length of 3 mm. is probably too small to be accurately determined by gross palpation. He found only one process less than 4 mm. long by this method. Taking Testut's and Hrdlička's figures of 1.0 per cent as correct for processes, one would expect to find 10 processes in every thousand humeri and assuming a fairly constant proportion of the other forms of the variation in a given group there would be 15 humeri having pronounced tubercles, 40 having small tubercles, and so on. Since by palpation the processes of 4+ mm. (i.e., those palpable) gave an incidence of 0.6 per cent, allowance for the processes under 4 mm. must be

made in using the figure obtained by palpation in comparisons with figures reached by methods which include processes of all lengths. In the light of Terry's recent work, I think that the figures 0.878 per cent and 1.16 per cent can be taken to represent the incidence at all ages and of adults respectively of normal white individuals having a palpable process. It must be borne in mind that the studies by which these figures were derived were upon subjects of the anatomical laboratories and dispensary, groups representing the more or less socially unfit and including individuals of very low mentality. However, even in the socially fit element it would be extremely hard to rule out conclusively from any man's heredity the taint of insanity, from which no walk of human life is free. Many of our literary geniuses (Reid '12) and political leaders (Clark '21) have shown more or less definite psychopathic conditions.

It will be recalled that Gruber found a high incidence (2.7 per cent) in his extensive study of the variation. Comparing his smaller figure with Gruber's, Testut intimates the effect of an ethnological factor, for he remarks that the process is rarer in France than it is in Russia and England. Ferdinando quotes a countryman (Calori) as expressing the opinion that there was perhaps the influence of an ethnological factor in the presence of the process. So far as the writer has been able to determine from the literature on the subject no special study of the incidence of this process has been made in races other than the Caucasian. If the process is an atavism, as Testut believes, one might expect to find a higher incidence of the process in the African negro, and perhaps a somewhat higher incidence in the American negro than is found in the American Caucasian. Terry ('21) does not think that his one case of bilateral supra-condyloid process in the negro can have much significance as evidence of its occurrence in the negro, since this particular individual could not be regarded as a pure type. I have found no other instance in the literature where a process has occurred in the negro; that its occurrence in colored races is rare is the general opinion. Before any conclusions can be drawn as to the influence of an ethnological or racial factor, more accurate data on the incidence in the several races must be available.

#### DISCUSSION OF INCIDENCE IN THE INSANE AND CRIMINAL GROUP

Nicolas, it will be remembered, gave the figures 7.8 per cent as the incidence among French insane. That figure is derived from the number of processes (nine) present in 115 subjects; the observations were made on the macerated humeri. Calculated on the number of individuals



having the variation (six), the incidence is 5.2 per cent. Likewise, Ferdinando's high figure of 11.29 per cent was made on a still smaller series of bones from Italian criminals, and as in the case of Nicolas the figure was based on the number of processes discovered. Both these figures are probably much too high.

Incidence of the supracondyloid process has been calculated by a number of investigators. Where the method of calculation is known, it appears that the frequency of the process in a series of arm bones of adult whites, apparently of not unsound mind, is approximately 1 per cent. What is the incidence of the process among those adjudged of unsound mind? Our problem must at the present time be pursued with those broad limits. We do not yet have a definition of insanity that is scientific and must indicate the condition by a utilitarian phrase formulated on the inability of a person to maintain himself and not menace the safety of those among whom he lives. Does a group of such defectives possess a higher incidence of the supracondyloid process than does a group of individuals which can maintain themselves in a community?

### III. OBSERVATIONS

The following cases of supracondyloid process were discovered in an examination of the arms of 1000 white inmates of the City Sanitarium of St. Louis, Missouri. Five hundred of these insane individuals were men and 500 were women. No attempt was made at this time to determine whether or not the present condition of the patient is an inherited or acquired psychopathic condition, nor was any attempt made to select the subjects of the examination according to the nature of the psychosis of the subject. The patients were taken at random, their arms palpated above the elbow and in the event of a supracondyloid process being found, the history recorded and an X-ray plate made of the humerus. The examination, devised by Terry ('21), is easy to make and does not cause the patient any greater discomfort than that attendant upon the palpation of the epitrochlear lymph nodes. The patient's right forearm is gently grasped just above the wrist in the left hand of the examiner and the elbow is gently flexed and the muscles over the lower third of the anterior surface of the humerus are lightly massaged until the confidence of the patient is gained and the muscles about the elbow are relaxed. By alternately partially flexing and extending the elbow it is possible to palpate the anterior aspect of the distal part of the humerus with the fingers of the right hand. The entire lower third of the antero-medial surface of the humerus is carefully explored for any unusual configura-

tion of the surface of the bone. If a supracondyloid process is present, it usually is very easily felt by the examining finger. Sometimes manipulation of the adjacent median nerve causes the patient to wince slightly. Examination of the left arm of the patient is made by reversing the special manipulations of the two hands of the examiner and proceeding as above described. In those cases where the supracondyloid process was found X-ray examination was made of the elbow. One-third of the cases failed to show any shadow of the process from the antero-posterior and lateral aspect altho the bony spurs were easily palpable. It was necessary to make X-ray plates of the humerus in the semi-lateral, or partially rotated position in order to demonstrate the processes satisfactorily. It might be noted here that these semi-lateral plates were made to suit the individual case, for by placing the arm over the plate in such a way that the process is entirely in silhouette, its entire length is shown in the finished plate and no difficulty is encountered in mensuration. Measurements were made whenever possible. The height of the process was taken as the perpendicular distance from the outline of the surface of the diaphysis of the humerus to the tip of the shadow of the process. The width of the shadow of the base of the process on the diaphysis was not always plain enough to measure. The length of the base of the process was measured in the same way. The distance of the most distal portion of the shadow of the base of the process to the lowest point of the trochlea was taken as the distance above the trochlea.

910. Female: German; 40 years old; father and one brother died of tuberculosis; married, 2 children; laundress; habits good. Diagnosis: Hysterical insanity. The patient had shown symptoms 18 years previous to admission. Her present attack began 2 years before admission. She was very nervous, mistreated her friends, had destructive tendencies, complained of imaginary pains, and believed that she could marry a millionaire.

The right humerus has a well marked process upon the anterior aspect of the diaphysis that feels very much like a tubercle (Fig. 1). The antero-posterior position does not show any shadow of the process, but the lateral aspect shows a shadow 1.5 mm. high on the anterior shadow of the diaphysis of the humerus. This process is much higher than 1.5 mm., but unfortunately the proper X-ray plate is not available for study. The process is at least 12 mm. long. The base is entirely obscured in both plates by the cortex of the diaphysis of the humerus, but it is located about 82 mm. above the trochlea.

The shadows of the two medial epicondyles are peculiar in that they both show a process-like shadow on the extreme end of the epicondyle (Figs. 2 and 3). These process-like structures appear to be continuous with the upper portion of the epicondyles by a strong bony connection which is more robust on the left side than on the right side. They are not as clearly shown in the pictures as in the X-ray plates.

1923. Female: German; 48 years old; married, 8 children, all living, no miscarriages; menses at 21 years of age. Diagnosis: Simple melancholia (recurrent). Brother died in the Sanitarium (paresis), and his son is also confined to the Sanitarium under a diagnosis of congenital idiocy (luetic). The patient imagined that her own son was in the Sanitarium.

The right humerus has an easily palpable process on the antero-medial aspect which casts a spine-like shadow in both the antero-posterior and lateral positions (Fig. 4). The shadow stands 2 mm. out from the medial edge of the shadow of the humerus in the antero-posterior aspect and 3 mm. out from the anterior edge of the shadow of the shaft of the humerus in the lateral position, thereby indicating that it is approximately 4 mm. high. It is about 7.5 mm. long and points downward, anteriorly, and medially. It is not possible to make out the base of the process on the shaft of the humerus, but it is about 75 mm. above the trochlea. The lateral epicondylar ridge has a slight eminence beginning 10 mm. above the epicondyle.

The left humerus is negative except that it shows a similar eminence above the lateral epicondyle.

1902. White female; age 40; German-American; married; illegitimate; uncle committed suicide over financial difficulties. Diagnosis: Manic depressive insanity. Onset sudden with suicidal tendencies, delusions of fire and attempted murder of husband and son.

The right humerus shows a large atypical process which is easily palpable as an eminence on the intermediate antero-medial aspect (Fig. 5). Both the antero-posterior and the lateral aspects show it standing 3 mm. high, so that evidently it is probably slightly higher than 4 mm. long and its width is at least 5 mm., but the plates give little that furnishes any indication as to the true width. It is about 70 mm. above the trochlea. The humerus is otherwise negative. The left humerus is negative.

1137. White female: age 44; American; housewife; married. At time of admission she was at the menopause. Diagnosis: Simple melancholia. The patient had always been melancholic and eccentric.



Onset was gradual but continuous. Had delusions of persecution and tried to commit suicide.

The right humerus shows in the lateral aspect a long fin-like shadow of a process which is pointing straight forward and obliquely downward (Fig. 6). It stands 5 mm. out from the humerus and is 8 mm. long. The base of the process is 4 mm. wide, 13 mm. long, and 62 mm. above the trochlea, and located on the intermediate antero-medial aspect of the shaft. The medial epicondyle is rather prominent. The left humerus presents no evidence of a supracondyloid process.

1700. White female; age 20; German-American; domestic; unmarried; menses normal. Patient and twin sister are congenitally luetic. A maternal uncle is insane. Diagnosis: Manic depressive insanity (recurrent). Her mental examination showed flight of ideas, noisy and destructive tendencies, impaired judgment, and hallucinations.

The left humerus shows a typical process 6 mm. high (Fig. 7) that bends downward after rising 2.5 mm. from its base which is 10 mm. long and located on the anterior aspect of the humerus, 70 mm. above the trochlea. The outer 3 mm. of the process casts a denser shadow than the base, indicating that there is more substance opaque to Roentgen rays in that portion of the process. The antero-posterior plate shows a slight shadow cast by the process, but there is nothing about it by itself that would indicate that a process was located in that region. Otherwise the left humerus is normal. The right humerus is negative.

1967. White female; age 26; German-American; housewife; married, two children. Father deserted the family, and the mother was sickly, but no insanity in the family. Physical examination showed that all tendon reflexes were increased and an enlarged thyroid gland present. Wasserman reaction negative. The patient had influenza a year or two ago and never fully recovered. Her husband mistreated her. Diagnosis: Dementia precox. Mental examination showed depression, little or no insight, hallucinations of a musical nature, persecutory delusions, memory poor for remote things, but good for recent occurrences.

The right humerus presents a typical process 4 mm. high which shows the notch in the distal surface 1.5 mm. from the shaft (Fig. 8). The base of the process is 12 mm. long, located about 70 mm. above the trochlea and on the anterior surface of the humerus. The antero-posterior position shows a small shadow 12 mm. long and 4 mm. broad corresponding to this location as described from the lateral view. The densest part of the shadow of the process is about midway its height corresponding with the notch above described and parallel to the shaft

of the humerus. The left humerus is negative except for an eminence on the lateral edge 20 mm. above the lateral epicondyle, which might possibly be due to a slight medial rotation of the humerus above the plate when the exposure was made.

1190. White female; age 54; American; seamstress; single; menopause six months before admission 10 years ago. No syphilis. Family history negative. Diagnosis: Dementia. No note on mentality was made upon admission.

The left humerus has a narrow spine-like process with a narrow notch 5 mm. deep in its distal edge (Fig. 9). The process is about 7 mm. high, with a long narrow base, 3 mm. broad and about 20 mm. long, which is located 52 mm. above the trochlea, and on the intermediate antero-medial surface of the humerus. The humerus shows a rather prominent eminence 10 mm. above the lateral epicondyle. The right humerus has a much slighter eminence above the lateral epicondyle, otherwise it is negative.

1231. White female; age 35 years; Irish-American; unmarried; did housework. Diagnosis: Dementia precox. The present condition of the patient began about two years previous to admission which was about a year after her menses became very irregular. Questionable goitre since patient was 20 years old. Mental examination showed persecutory sexual delusions, sexual perversions, disorientation for time and place, insight poor, and memory good.

The right humerus has blunt triangular process 5 mm. high with a slight tendency to hook downward (Fig. 10). The base is 28 mm. long and located on the medial edge of the humerus 47 mm. above the trochlea. At first there was some question as to whether this process was palpable. The X-ray plates did not show any signs of a process when taken from antero-posterior or lateral aspects, but when taken in a semi-lateral position, the process was clearly demonstrated in silhouette as plainly as any of the other processes have been shown in the X-ray plates. The left humerus shows no trace of a process and is otherwise negative.

474. White female; age 62; American; widow, one child. Physical examination some time after admission 30 years ago showed a myoma of the uterus. Diagnosis: Paranoia. Mental symptoms began three years previous to admission making themselves manifest by fighting, talking to herself, and persecutory delusions. The exciting cause was probably alcoholism.

The left humerus has a typical process, 5 mm. high, with a base 16.5 mm. long located on the extreme medial edge of the anterior aspect 65 mm. above the trochlea (Fig. 11). The tip of the process is 2 mm. thick and turns distally for 3 mm. and arises from a truncated base 2 mm. high, so that there is a well-defined notch in the distal aspect of the process. The antero-posterior and lateral X-ray plates showed no sign of the process which can be felt on the extreme medial edge of the anterior aspect of the humerus. To palpation it is a small, sharp-pointed process that causes some discomfort to the patient when the tissues over it are manipulated. The semi-lateral position shows it as above described. The right humerus is negative.

1006. White female; age 84; nativity unknown; married; family history is incomplete and apparently negative. Diagnosis: Senile dementia; kleptomania. Mental examination showed delusions of persecution; disorientation for time, place, person; and memory for recent events poor, but good for remote events; an impaired judgment.

The left humerus in the semi-lateral position casts a shadow of a spine-like process 4.5 mm. in height arising from a truncated base 1.5 mm. and 14 mm. long on the medial edge of the anterior aspect and 70 mm. above the trochlea (Fig. 12). This process is small and sharp pointed to palpation, but the X-ray plate shows a slight notch in the distal edges. Manipulation of the tissues over the tip of the process causes the patient to wince. The X-rays from the antero-posterior and lateral aspects were reported negative by the roentgenologist, but later a very faint shadow of a process 2.5 mm. long was made out projecting from the medial edge of the humerus about 75 mm. above the trochlea. The right humerus is negative.

1975. White female; age 33; American; unmarried; housework. The patient has four sisters, but there is no family history of insanity. Physical examination disclosed an atrophic uterus in movable retroversion, and atrophic breasts, and menstrual disturbances. Diagnosis: Dementia precox.

A process is palpable on the anterior aspect of the left humerus which the X-ray plate with the humerus in the semi-lateral position shows as a typical process, 5.5 mm. high with a base 14 mm. long and 59 mm. above the trochlea (Fig. 13). The tip of the process points downward and is beak-like in form. The antero-posterior and lateral aspects show no shadow whatever of the process. The anterior aspect shows a small notch on the medial epicondylar edge 38 mm. above the trochlea which



is in direct line between the trochlea and the tip of the process. This notch might possibly be associated in some way with the insertion of the fibrous band from the tip of the process to the anterior surface of the humerus.

The semi-lateral aspect of the right humerus shows a shadow of a triangular process 4 mm. high with a base 10 mm. long and 63 mm. above the trochlea (Fig. 14). The process is palpable on the anterior aspect of the humerus. There is nothing distinctive to palpation except that it is rather more prominent than its mate on the left humerus. The plates from the antero-posterior and the lateral position of the arm did not show a shadow of a process. The medial epicondylar edge shown in the antero-posterior view shows a shallow notch similar in form and position to the one described on the left humerus.

1665. White male; age 41; English; unmarried; clerk; father, epileptic; sister, neurotic; maternal cousin died from tumor of the brain; no syphilis. The patient was the second child, normal delivery and infancy, failed to graduate from grammar school, subsequently could not hold a job except for a short time. Diagnosis: dementia precox.

The left humerus has a definitely palpable process on the intermediate antero-medial aspect which feels like a tubercle. The lateral position shows nothing, but the antero-posterior plate shows a faint shadow of a process in the above described location and appears to be a typical process, 5 mm. high and about 7 to 10 mm. long at the base which is probably about 4 mm. broad and about 80 mm. above the trochlea (Fig. 15). The plate shows the dimensions better than the print from the plate, but at best the dimensions can only be estimated, altho the shadow of the process is quite evident. There is another shadow on the medial edge of the left humerus about 2 mm. high and 10 mm. long which drops abruptly to the metaphysis of the humerus 30 mm. from the medial epicondyle and gives one the suggestion of a groove in the medial edge. On the lateral edge of the humerus 10 mm. above the lateral epicondyle is an eminence. The right humerus has no process and the medial epicondylar edge is perfectly smooth.

#### IV. DISCUSSION

The chief results of our examination, taken from the foregoing record of observations, are as follows:

Number	Sex	Side		Height mm.	Distance above trochlea mm.	Diagnosis
		R	L			
910	F	+	0	1.5+	82	Hysterical insanity
1923	F	+	0	4.0	76	Simple melancholia
1902	F	+	0	4.0+	70	Manic depressive insanity
1137	F	+	0	5.0	62	Simple melancholia
1700	F	0	+	5.5	70	Manic depressive insanity
1967	F	+	0	4.0	70	Dementia precox
1190	F	0	+	7.0	52	Dementia
1231	F	+	0	5.0	47	Dementia precox
474	F	0	+	5.0	65	Paranoia
1006	F	0	+	4.5	75	Senile dementia
1975	F	0	+	5.5	59	Dementia
		+	0	4.0	63	precoc
1665	M	0	+	5.0	80	Dementia precoc

Calculating the incidence on the number of individuals presenting a palpable variation, viz., 12 in 1000, the result is 1.2 per cent. By the same method of examination and calculation Terry found the incidence in a series of 1000 dispensary patients to be 0.7 per cent. Of these 317 were negroes, 683 whites in which group there were 6 individuals presenting the process, all unilaterally. The incidence of the variation in the white group is therefore 0.878 per cent. Although this group of 683 contains members under 21 years, the fact that the process has been found among children and adolescents, seems to make it necessary to draw it into the comparison. On the basis of age it appears that in the group of insane there is a considerably higher incidence of individuals having palpable processes. But by limiting the comparison to the adult whites the figures will be 1.2 per cent (insane) and 1.16 per cent (dispensary). Among the insane only 0.2 per cent of males had the variation; 2.2 per cent of females presented it as compared with 0.95 per cent and 0.878 per cent of all whites in the dispensary group.

In order to compare our figure with that of Nicolas two points must be considered; (a) allowance for the presence of tubercles or processes under 4 mm., (b) the limited series studied by Nicolas. Unfortunately,

Nicolas' measurements are not available and while it is improbable that all of his 9 processes in 115 subjects were 5 mm. and over in height, yet it would be unsafe to do more in this case than to consider the probability of a certain decline in his figure of 5.2 per cent by elimination of possible small processes. It has already been pointed out that the high incidence may be charged in part to error from studying too limited a series. In the present examination of 500 insane white men for the presence of the supracondyloid process that variation was discovered not until the 280th individual had been reached. Contrary to this experience, in one ward composed of white women, the first inmate examined presented the process bilaterally, the 13th, 14th, 15th, and the 17th possessed it unilaterally. There were 49 women in this particular ward (CII). In the very next ward (DII) there were 52 inmates and one more process was found. If one were to have been satisfied with such a small number of examinations and chance had directed him to these two wards, the incidence of supracondyloid processes would have been reported as 6 or 7 per cent as the investigator saw fit to calculate it by the number of individuals with the variation or by the frequency of the variation itself. One hundred sixty-six insane women had been examined just previously in different wards without finding a single instance of the process. Likewise had the investigator been content with this small number, the process would undoubtedly have been reported as absent in insane women, which is obviously untrue. The writer's criticism of the results of other investigators (and of his own as well) does not lie so much in the interpretation of their findings, as in the limitation of their investigations, which were doubtless as extensive as circumstances would permit.

As to the incidence of processes, there were 13 palpable in 2000 humeri, i.e., 0.65 per cent, as against 0.58 per cent in the group of adult white persons studied by Terry. Among the normal the process had an incidence of 0.61 per cent and of 0.55 per cent in males and females respectively in comparison with 0.1 per cent and 2.4 per cent respectively in the insane.

In regard to symmetry, the table shows that the process was on the right arm 7 times, on the left 6 times, and on both in one instance. Therefore, with respect to symmetry, the group of insane present practically the same status as did the group of the population at large studied by Terry.

An equal number of men and women were examined, but the process was discovered in only one man. Is this significant among the insane or



may the distribution in this class be equal as it appears to be from studies of the normal and an explanation of the discrepancy sought in the possibility in this one group of an unusually large proportion of processes under 4 mm. (and therefore not palpable) in the male? It is a fact that in the examination of the living the greater musculature of the male tends to obscure the presence of a supracondyloid process.

The incidence of the process seems to bear no definite relation to any particular type of insanity. Five of the 12 different family histories are definitely psychopathic and a careful investigation, if it were possible, would certainly increase this number considerably. The type of insanity represented in the cases presented all have a strong tendency to inheritance (Rosanoff and Orr '11). In no case can syphilis or other acquired conditions be said to have brought about insanity in these individuals. Apparently the high incidence of the variation in one ward is merely a coincidence; there was no special class of mental defectives in that group.

A study of the protocols for the 10 women shows a high incidence of possible endocrinous abnormalities if menstrual disturbances are so significant as some diagnosticians now regard them. The point is brought up because it is of great importance from a psychiatric standpoint and is so frequently part of the general picture of insanity. Moreover, since the process is a hereditary anomaly (Struthers '73, Terry '21) which is found in the insane who inherit anomalies of the endocrine system, it must be kept in mind that a faulty endocrine system may be responsible for the presence of the process.

In one of the subjects studied variation of the medial epicondyles was noted. This observation is of interest in view of the discovery by Terry of ossicles at the same spot in two cases studied by him. His observations of the participation of the medial epicondyle in the development of the supracondylar bar in the cat may have some significance in explaining the origin of these variations.

It should again be emphasized that the present discussion of incidence has reference to calculations based only on the observation of palpable processes. It is probable moreover that in the examination of the living the variation even to the length of 4 mm. may have been overlooked in one of the cases notwithstanding all care and precaution. There is therefore a possibility of error in the direction of underrating the incidence to some small degree.

#### V. CONCLUSIONS

In 1000 insane white people the supracondyloid process was found in 12 individuals, or in 1.2 per cent.

In 500 insane men the process was found only once, or in 0.2 per cent of men and in 0.1 per cent of arms.

In 500 insane women 12 processes were found in 11 individuals, or in 2.2 per cent of women and in 2.4 per cent of arms.

In comparing the figures with the figures of Terry (1.16 per cent incidence in adult white dispensary patients) there appears to be no significant difference.

Nicolas' ('90) high figures (5.2 per cent in 115 insane individuals) on the incidence of insane individuals presenting the variation are not borne out by the results of this investigation.

. . . .

The writer wishes to acknowledge the kind assistance and willing cooperation of Dr. G. A. Johns, Superintendent, and of Dr. James Lewald, Assistant Superintendent of the St. Louis City Sanitarium, in carrying out this investigation.

#### VI. BIBLIOGRAPHY

- Clark (L. Pierce)—Psychiatric Study of Abraham Lincoln. *Psychoanal. Rev.*, 1921, VIII.
- Cunningham (D. J.)—Supracondyloid Process in Children. *Jour. Anat. and Physiol.*, 1899, XXXIII.
- Ferdinando (U.)—Supracondyloid Process in the Humerus in Normal & in Delinquent People. Parma, 1899.
- Gruber (W.)—Supracondyloid Process. *Edinburgh Med. & Surg. J.*, 1841, LVI. Monographie des Canalis supracondyloideus humeri. *Mem. Ac. Sc., St. Petersburg.*, 1859, III.
- Nicolas (A.)—Nouvelles Observations d'Apophyse sus-epitrochléenne chez l'Homme. *Rev. Biol. du Nord.*, 1890, III.
- Poirier (P.) et Charpy (A.)—Traité d'Anatomie Humaine. Paris, 1911, I.
- Poulet.—Note sur une variété d'extose de l'humerus. *Bull. et Mem. de la Soc. de Chirurg.*, 1883, IX, p. 467.
- Reid (E. C.)—Manifestations of Manic Depressive Insanity in Literary Genius. *Am. J. Insan.*, 1912, XLVIII.
- Rosanoff (A. J.) & Orr (F. I.)—A Study of Heredity in Insanity in the Light of the Mendelian Theory. *Am. J. Insan.*, 1911, LXVIII.
- Struthers (J.)—Supracondyloid Process. *Lancet*, 1863, I., p. 87. On Hereditary Supracondyloid Process in Man. *Lancet*, 1873, I, p. 231.
- Terry (R. J.)—A Study of the Supracondyloid Process in the Living. *Am. J. Phys. Anthropol.*, 1921, IV.
- Testut (L.)—L'Apophyse sus-epitrochléenne chez l'Homme. *Internat. Arch. f. Anat. & Phys.*, 1889, VI.
- Valenti (G.)—Supracondyloid Process of the Humerus in Two Criminals & On, Insane. *Atti e Rendic. Acc. Med.-Chir. Perug.*, 1896, VIII.

## VII. ILLUSTRATIONS

## Explanation of Figures

- Fig. 1. Lateral plate of the right humerus of subject 910.
- Fig. 2. Antero-posterior plate of the right humerus of subject 910, showing variation of medial epicondyle.
- Fig. 3. Antero-posterior plate of the left humerus of subject 910, showing variation of medial epicondyle.
- Fig. 4. Antero-posterior plate of the right humerus of subject 1923.
- Fig. 5. Antero-posterior plate of the right humerus of subject 1902.
- Fig. 6. Lateral plate of the right humerus of subject 1137.
- Fig. 7. Lateral plate of the left humerus of subject 1700.
- Fig. 8. Lateral plate of the right humerus of subject 1967.
- Fig. 9. Lateral plate of the left humerus of subject 1190.
- Fig. 10. Semi-lateral plate of the right humerus of subject 1231.
- Fig. 11. Semi-lateral plate of the left humerus of subject 474.
- Fig. 12. Semi-lateral plate of the left humerus of subject 1006.
- Fig. 13. Semi-lateral plate of the left humerus of subject 1975.
- Fig. 14. Semi-lateral plate of the right humerus of subject 1975.
- Fig. 15. Antero-posterior plate of the left humerus of subject 1665.



PLATE I



PLATE II



Fig. 4

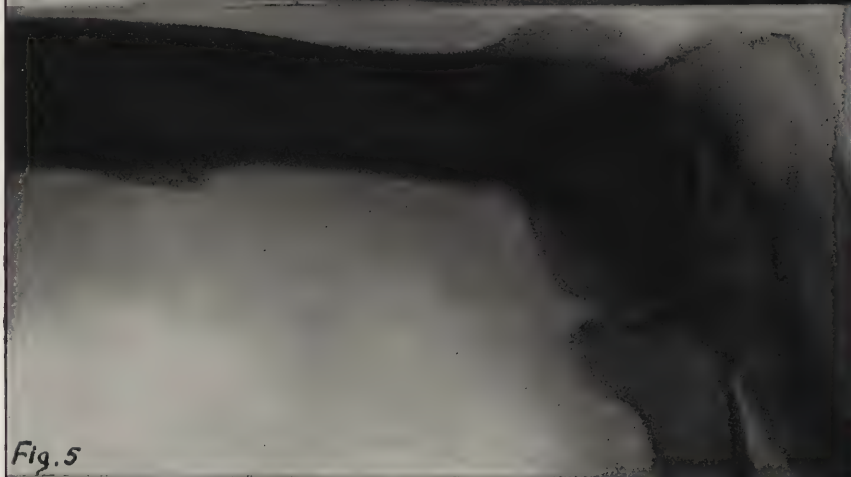


Fig. 5

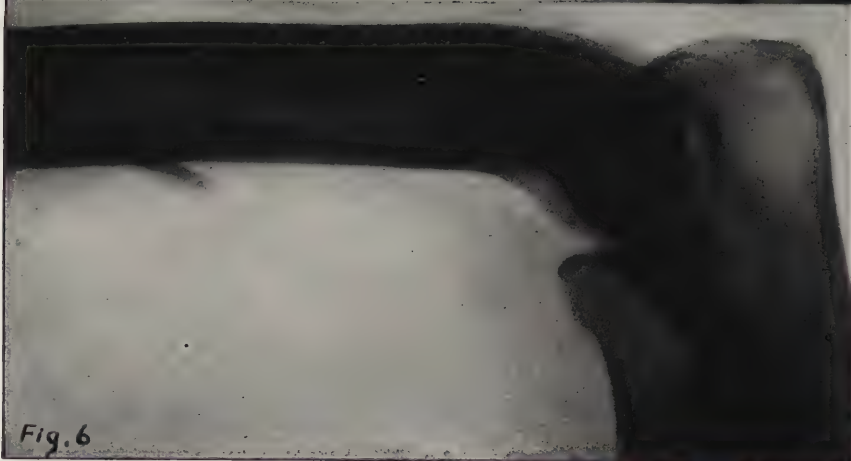
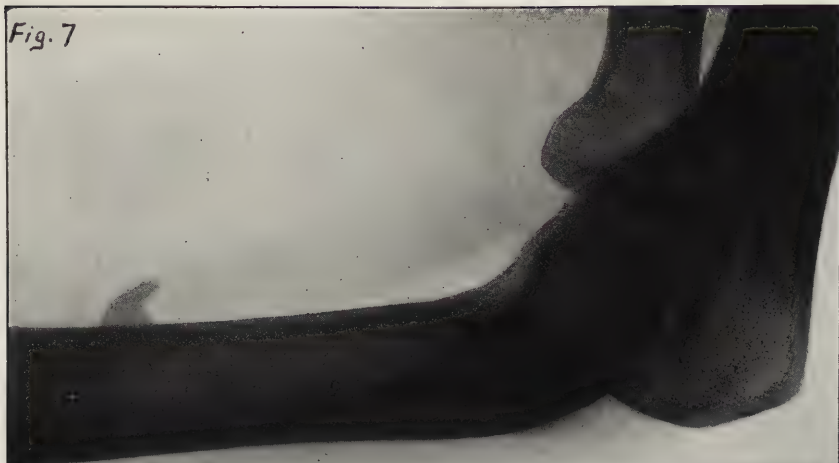


Fig. 6

PLATE III

*Fig. 7*



*Fig. 8*



*Fig. 9*

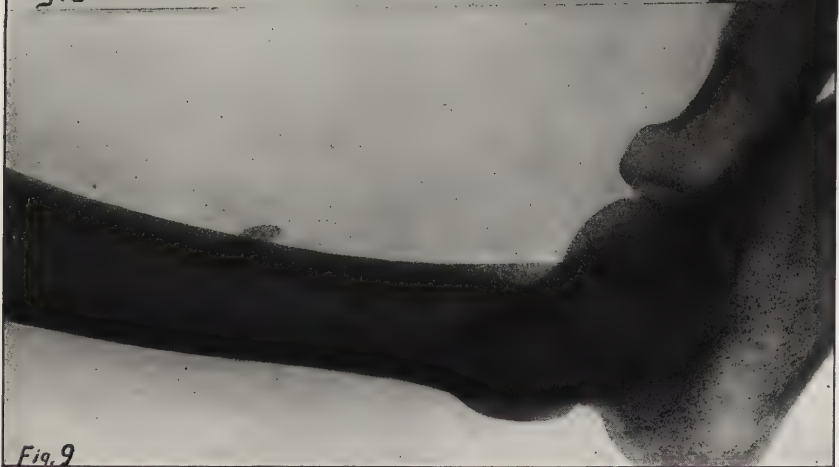




PLATE IV

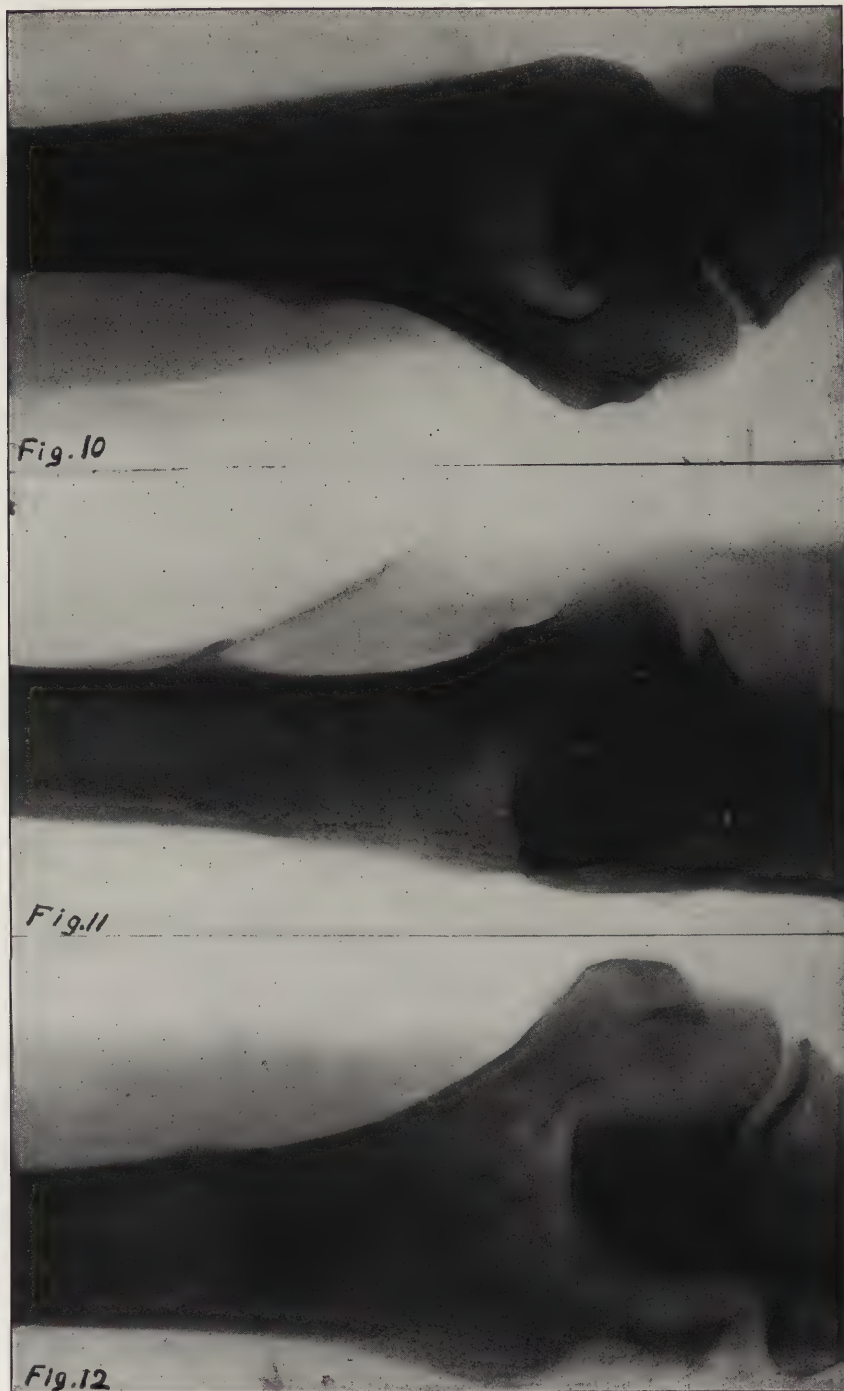
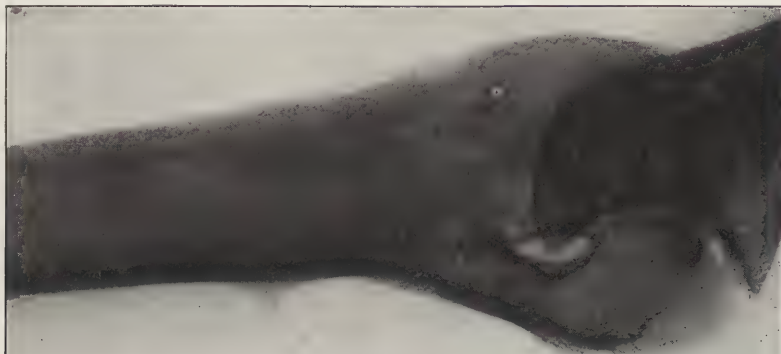


PLATE V



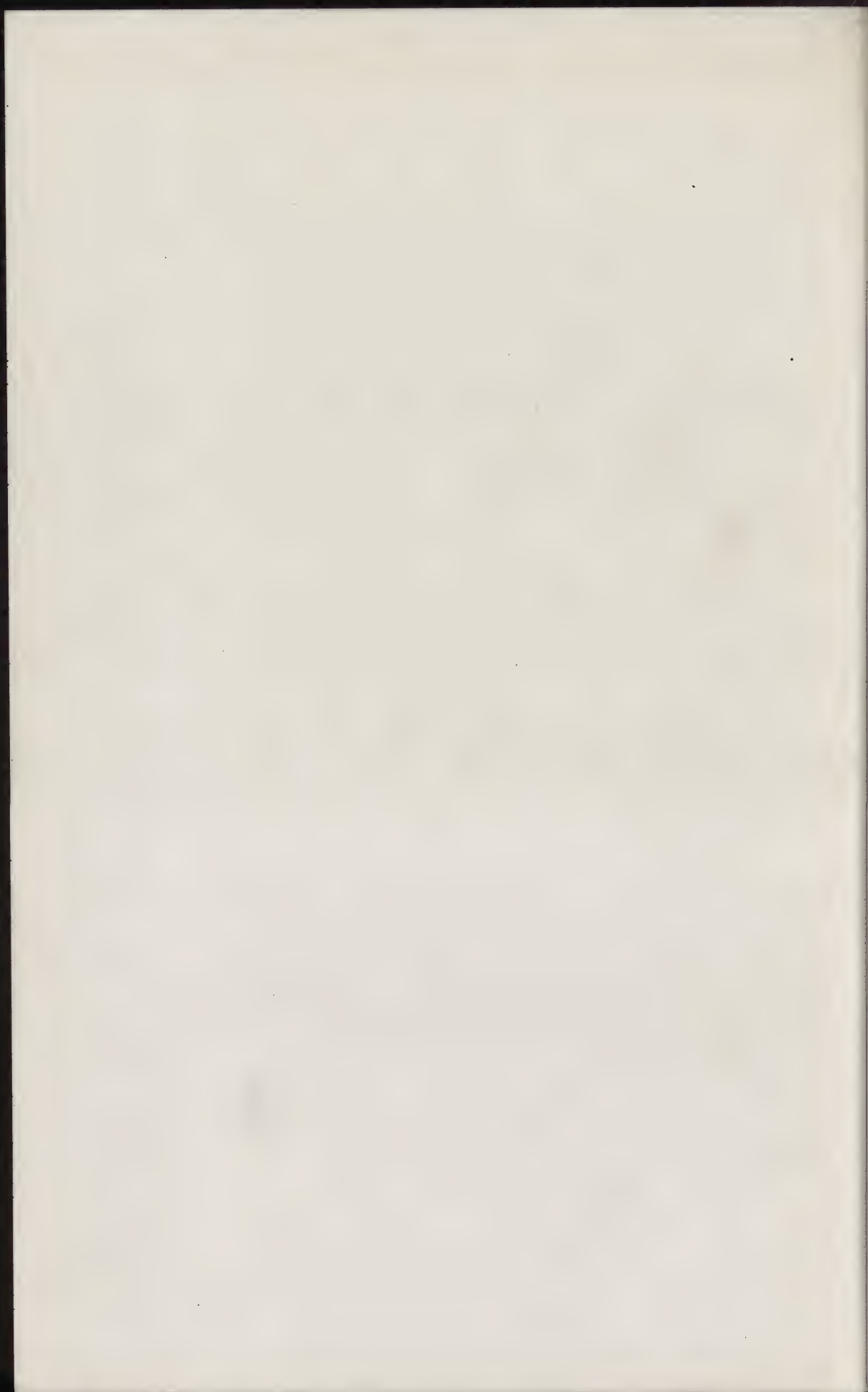
*Fig. 13*



*Fig. 14*



*Fig. 15*





## CONGENITAL DEFORMITIES IN DRAFTED MEN

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During the early summer of 1918, while functioning as Chief of the Orthopedic Examining Board at Camp Devens, Massachusetts, I noted a number of physical defects of congenital origin.

As the draftees were presenting themselves at the rate of several thousand a day at that time, I decided to make a comparative study of these conditions, and so arranged with the other members of the board to refer these cases to me for notation of defects.

Two teams were examining. A team consisted of two medical officers and their clerks, one of the officers of each team devoting himself to the examination of foot conditions, the other to observation of the spine, bones and joints. In this way each man was subjected to a thorough going-over and chances of missing a deformity were minimized.

Twenty thousand men were examined in this series, of whom fifteen thousand were white and five thousand colored. An opportunity was thus afforded for obtaining comparative data on the incidence of deformity occurring among the two races.

I shall endeavor to describe briefly some of these deformities; the relative incidence of right sided deformities as compared with those on the left; also the number of bilateral deformities; and of those confined only to the trunk.

### INCIDENCE OF DEFORMITY IN THE WHITES

Of the fifteen thousand white men examined, practically every nationality was represented, the majority being from the Eastern and middle Western States. There is no doubt but what a few cases were eliminated by the original draft board but the following descriptions will show that the policy at that time was to send almost every one to Camp for the final decision of the Army Medical Staff.

I was able to eliminate a number of cases which at first sight appeared to be congenital in type. Most of these were relegated to the category of late rickets, osteomalacia and trauma. In all thirty-eight cases unquestionably congenital in type were found, making an incidence of one-fourth of one per cent. Of these cases 18 per cent plus showed

right-sided defects involving either the right arm or leg, while 15 per cent plus occurred on the left side and 15 per cent were bilateral. The remaining 50 per cent were anomalies of the trunk.

The deformities of the extremities were chiefly cases of ectrodactylism, syndactylism, polydactylism, double phalanges and abnormalities in the number of tarsal or metatarsal bones.

The anomalies of the trunk were Pectus excavatum, Sprengles' Shoulder, Pilonidal Sinuses, Polymastia, Froilich's Triad, Spina Bifida with other developmental deformities of the spine, and convoluted Dermoid Cysts.

*Incidence of Deformity in the Negro.* The majority of the five thousand negroes examined were from Florida, representing mostly pure or nearly pure Negro blood. The anomalies manifested in this group were of the same type as those found in white men, but were greater in number, the incidence being 36-100 of one per cent as opposed to 25-100 of one per cent as shown in the whites. Of these 11 per cent were right-sided, 33 per cent left-sided, 50 per cent bilateral, and one per cent were defects of the trunk.

*Comparative Analysis of Statistics.* Analysis of these figures shows 18 per cent right-sided deformity in the white, 11 per cent in the colored; 15 per cent left in the white, 33 per cent in the colored; bilateral 15 per cent white, 50 per cent colored. Trunk deformities existed among the whites in 50 per cent of the cases as opposed to one per cent in the colored.

*Prevalent Deformities Among the Negroes.* The most prevalent deformity in this group was Polydactylism. Of these five were accessory toes and five were accessory fingers. Of the accessory toes three were on the left side, two on the right; while the five accessory fingers were all bilateral.

*Prevalent Deformities Among the Whites.* Syndactylism existed more frequently than any other defect among the whites. Nine cases of this were noted, occurring seven times in the feet and twice in the hands. In the former instance it was the second and third toes which were connected by a web in each case. This occurred four times on both feet and three times on the left foot.

The two incidences in which the hands were involved showed webbing of the third and fourth fingers of the right hand once, and webbing of the fourth and fifth fingers in both hands once.

*Involvement of All Extremities.* Three men presented deformities of both hands and both feet, two of these men were colored and one was white.

One of the negroes had six toes and six fingers; the extra digit in each case arose at the fifth metatarsal and fifth metacarpal phalangeal junction respectively. This man showed five metatarsal and five metacarpal bones only. The other negro was of especial interest, as three different types of deformity were represented as follows: the left foot had six toes, the fourth and fifth fingers of each hand were joined by a web which extended to one quarter of an inch of the end, while the right thumb presented two distal phalanges.

The white man in this series was a simple case of syndactylism, webbing occurring between the fourth and fifth fingers of both hands and the second and third toes of both feet.

#### POLYMASTIA

Figure 2 shows the only case of Polymastia in this series. The additional nipples are placed slightly below and internal to the normal location. As can be seen in the picture this anomaly is represented in an adult male negro.

Numerous theories have been advanced as to the causes of Polymastia. Among them are Ahlfelds who states that the condition is due to the dislocation of the primordial mammary cells by the amnion; Champney who thinks that the supernumerary glands are enlarged and modified sweat glands which, due to the accelerated activity of the dermal glands during pregnancy and lactation give off a modified milky secretion; and Darwin who believes that the phenomenon is atavistic, stating that "Ontogeny recapitulates the Phylogeny." And there is no doubt but that during the development of the foetus, phylogenetic resemblances to mammalian ancestors do appear. Among different anomalous locations for additional lacteal glands are: axilla, thigh, labia majora, xyfoid cartilage, back of neck, inner aspect of arm, on the buttocks and over the anterior spinous process of the ileum.<sup>1</sup>

Bruce in his investigation of three thousand nine hundred and sixty-five persons found in sixty-one a supernumerary nipple. Leichenstern states that this type of deformity occurs once in five hundred times. They both believe that men present the anomaly twice as frequently

<sup>1</sup> I unearthed an old print in London showing a child nursing from a well-developed nipple on the outer margin of the left thigh.



as women. It would seem that these figures are too high, as it would have been quite impossible for us to miss thirty-nine cases of so prominent a malformation.

#### SPRENGEL'S SHOULDER

In the white contingent there were three cases of Sprengel's shoulder while among the negroes there was one case. Twice the right shoulder was involved and twice the left. All of these men were unable to abduct the arm above a right angle. Two of them presented what at first appeared to be an exostosis of the shoulder blade, which was, however, caused by a curving forward of the supraspinous portion of the scapula. This is due to the fact that the scapula in its abnormally high position is subjected to the unusual forward pull of muscles which in the young soft bone bend the supraspinous portion forward.

The most pronounced case showed an elevation of the scapula of ten centimeters. Figure 3 shows the internal rotation of the left scapula and its juxtaposition to the spine. Figure 4 is an anterior view of the same case. This man's left arm was apparently two inches longer than the right when both extremities were extended forward together. Accurate measurements, however, showed that both arms were twenty-two inches from the great tuberosity to the styloid process of the radius, while measuring from the seventh cervical to the latter point they were both twenty-seven and a half inches in length.

This apparent discrepancy may be explained by a forward rotation of the scapula. This case showed much atrophy of the left rhomboideus muscle but with a straight spinal column, while the others all showed scolioses. Figure 5 shows the broad short scapula which is characteristic of this condition; also the internal rotation of the inferior portion of the scapula. Twice the inferior angle of the scapula was rotated towards and in two instances away from the spine. Figure 3 and Figure 6 are illustrative of this deformity. In the former there is an inward rotation associated with very slight spinal curvature, while in the latter the scapula shows the inferior angle rotated outward, this being associated with marked scoliosis and rotation of the spine. Zinc oxide ointment was used to outline the parts.

The radiographic report of Case 3 Figure 6 states that besides the malformation of the scapula there exists a rarefied area in the region of the great tuberosity of the humerus. I quote this because I desire to offer a postulate as follows: These cases in which the inferior angle of the scapula is rotated mesially are unable to abduct the arm above a right

angle. In these cases the glenoid faces downward rather than toward the horizontal, which places the abductor muscles at such mechanical disadvantage that abduction above the right angle is limited. Further the inward rotation of the scapula approximates the origin and insertion of the supraspinatus muscle, which rises from the inner two-thirds of the supraspinous fossa and inserts into the great tuberosity.

The function of the supraspinous muscle is abduction for the first 10 degrees, after which angle is passed the biceps and deltoid commence to function. In this type of Sprengles' Shoulder the angle formed by the articulation of the head of the humerus with the glenoid cavity is much less acute than normal, approaching nearer the straight line, thus enabling the deltoid and biceps to function during the first ten degrees of abduction and entirely eliminating the work of the supraspinatus.

Wolf's Law states that the structure of bone is determined by the internal reaction of the individual bone to the body weight and the stress and strain of muscular activity. Obviously the stress of the supraspinatus on the great trochanter being eliminated, bone formation is at the minimum, thus accounting for the rarefied area.

#### PECTUS EXCAVATUM

There were four cases in which the sternum formed a concavity or depression below the normal level of the thorax. The most marked deformity of this nature occurred in a young white adult in whom the entire sternum was depressed forming with the costal cartilages a hollow measuring 12 centimeters in depth. The chest had compensated, the lateral diameters being much increased.

#### FROELICH'S SYNDROME

There were three cases of Adipose Genital Dystrophy, a condition that has been so ably described by Froelich and Hartel. These individuals all presented much subcutaneous fat with a decided tendency towards the *typus feminis*. One in particular was of especial interest as the hypoplasia of the sex organs was displayed to a most marked degree. He or it weighed in the neighborhood of two hundred pounds, had much subcutaneous adiposa, a large pelvis, female disposal of the pelvic hairs, large breasts and a high voice with a penis less than an inch in length. No testicles could be palpated either in the sac or inguinal canal.

## POLYDACTYLISM

As has been previously stated, Polydactylism was found as the most prevalent deformity among the colored men. Figures 9 and 8 both show a rather characteristic deformity as seen among the negroes. Figure 9 shows a white adult in whom an accessory digit is shown coming from the carpal bone of the right thumb. For other examples of this deformity see Figures 7, 8, 9, 10, 11 and 12. Polydactylism is generally bilateral and hands are more frequently affected than feet. Also the extra digits are generally attached to the ulnar and fibular side of the extremities and are rarely interpolated between normal digits. Males are more often affected than females, heredity being the most important etiological factor.

In this series there were thirteen cases noted altogether of which six were bilateral, three right-sided and four on the left side. There were five cases of accessory toes and seven of accessory fingers. One case showed accessory digits on both feet and both hands. This occurred in the negro who had six toes on both feet, the sixth digit coming from the fifth metatarsal bones. There were also six fingers, the accessory digits coming from the metacarpal bone of the fifth finger at its distal extremity.

Of the accessory fingers one occurred on the right hand coming from the metacarpal-phalangeal junction of the fifth finger, while one came from the thumb of the left hand. In another case the extra digit grew from both thumbs. In the four other cases the deformity was bilateral, the supernumerary digit coming from the little finger of each hand.

Those having accessory toes were five in number. Of these four had an extra digit coming from the little toe at the distal extremity of the metatarsal, while the fifth case was that of an accessory digit growing from the great toe.

## SYNDACTYLISM

As has been previously stated this was the most prevalent deformity among the whites, occurring in all twelve times as follows: Involvement of toes eight times, of fingers four times, and one case in which the anomaly occurred in both hands and feet in the same individual. In the latter it was the fourth and fifth digits of both hands and feet which were involved.

The third and fourth fingers were connected by a web on the right hand once. Another case showed involvement of both hands, while a third showed webbing of the second, third and fourth fingers of the left hand.



Toes were affected as follows: In five cases the second and third toes of both feet were involved, while in three others the same toes were webbed on the left foot only. Figure 14 shows a white adult in which the second and third toes of each foot are webbed the entire length to the toe nail. Figures 13 and 15 present the deformity as rather typical of the type as seen in the hand. Case 20, Figures 16, 17, 18, 18-A and 19 shows a rather interesting condition. This case was operated by Dr. Samuel Robinson to whom we are indebted for the photographs. The radiograph of the right foot shows that the fourth and fifth toes are matted together, the bifid nail of the fifth suggesting extra phalanges. The extra digit grows from the carpal bone of the fourth toe (Figs. 18, 18-A).

Tubby states that webbing extends as a rule to the first phalangeal joint and that the thumb is rarely involved. The latter fact is due to the early differentiation of the thumb from the fingers, which occurs as early as the seventy-fifth day of intrauterine life. The fingers are primarily all connected and gradually separate as the foetus develops; obviously any arrest in this process would be responsible for webbing or any modification thereof. The structures of the web generally consist of fibrous tissue and skin, there being very little or no muscle elements present. Ballantyne has stated that the hands are more often affected than the feet. However, in this series the opposite was true, the anomaly occurring twice as many times on the feet as the hands.

#### ECTRODACTYLISM

Congenital absence of a digit is very uncommon and it has been stated that the condition was due to amniotic inflammatory adhesions or intrauterine amputations. Figure 20 represents this condition, the only one of its kind in the series. It occurred on the right foot of a young white adult. This man had only four metatarsal bones and four phalanges, the circumference of each foot, however, was eight and three-quarters inches; this no doubt being due to hypertrophy of the soft parts of the right foot, each foot being subject to similar stress. The presence of four metatarsals rather goes to refute the theory of intrauterine adhesions or amputations.

#### MEGALOSYNDACTILIA

Figure 21 shows one of the three cases noted, which occurred on the right foot of a white officer, thirty years of age. This digit measures one and one-half inches in length and four and one-half inches in circum-

ference. The nail shows a distinct furrow running from the matrix distally to the margin. This furrow is immediately over the demarcation line between the two distal phalanges. (See Fig. 22.) This case represents to my mind one of the steps in the evolution of polydactylism. If the deformity had been continued the furrow in the nail would have progressed through and between the two bones, with an additional digit resulting. There were three of these cases. Figure 23 shows one of the other two in which the distal phalanx of the great toe is only partially separated. This evidently represents an earlier step in the evolvement of which the end product is polydactylism. The distal phalanges of the second and third toes also show a notching at the end. Figure 1 shows another step, while Figure 7 represents the complete separation.

It is believed that Megalosyndactylism, syndactylism and polydactylism are all products of the same primary abnormal condition, and that they all represent different developmental defects the ultimate stage of which is represented by completely isolated digits of either normal or increased number.

#### TORTICOLIS

There were two cases of this condition both in whites, and both giving a history of deformity from birth. In both instances the condition was bilateral, the head being deviated forward on the shoulders with only slight rotation. This is a very rare condition. Tubby states that in his service in the Royal National Orthopedic Hospital it occurred only fifteen times out of 5079 cases. There was some asymmetry of the face shown by both of these men. Both sterno-cleido-mastoid muscles were contracted, but in each case there was more contraction of one muscle than the other.

#### SPINA BIFIDA

This deformity shows an incidence of two in this series. Fig. 24 illustrates this developmental defect which included the fifth lumbar vertebra and the entire sacrum with deviation of the coccyx to the right at an angle of  $35^{\circ}$ . The skin presented a large pigmented area fifteen centimeters in diameter with a small hairy area at the fifth lumbar vertebra. A depression could be felt at this point, from which a meningocele protruded every few weeks only to recede again. This occurred in a man twenty-five years of age of Irish extraction; he complained of pain and tenderness over the lumbar region, which had been present for

about ten years. The other case also showed a patch of long hair at the fifth lumbar, five centimeters square. The site at which the meningocele protruded presented a depression two and one-half centimeters in circumference and was a deep red in color. This man was white, twenty-one years of age and gave a history of easy fatigue and continued pain and aching in the back.

#### DERMOID CYST

This deformity was seen only once, but in rather an interesting and unusual form. It presented a convoluted hard mass eight centimeters in diameter and five in depth, the convexity protruding most of this distance above the level of the skin. This mass occupied the left gluteal region and gave no history of pain, suppuration or discomfort of any kind. The X-Ray of this case was negative.

It might be stated here that most of the deformities of this type and that described under *Spina bifida* show over or adjacent to the anomaly an area of pigmentation or an excessive growth of hair, or both.

#### CONGENITAL RELAXATION OF LIGAMENTS OF KNEE

Figures 25-26 illustrate the only deformity of this type met with. The luxation of the joint is entirely lateral, the deviation of the leg and thigh forming an angle of  $100^\circ$  instead of  $180^\circ$ . This occurred in the right leg of a Florida negro, aged 22 years, and was apparently caused by an extreme relaxation of the lateral ligaments of the knee; the crucial ligaments were only very moderately relaxed as there was no antero-posterior luxation. This man gave a history of having worn a brace from as early as he could remember until seventeen years of age, at which time he left home. He thinks that he was born with the defect and that he was fitted with this brace while very young. During the last five years he has worn no brace or support of any kind. The right leg showed considerable atrophy of disuse as he necessarily favored the left leg. The reflexes, however, were normal and all of the muscles functioning. Little difficulty was encountered in reducing the dislocation. The normal relations are shown in Fig. 26. However, a slight amount of movement or the weight of the body easily threw the knee out again to the position as shown in Fig. 25. There was no intracapsular reaction or pain accompanying this movement, which apparently represented a minimum amount of trauma. I have failed to find a report of a similar case in the literature.



## SYPHILIS

The group of negroes was largely made up of draftees from the South, Florida having an especially large quota. There was a large percentage of venereal disease among these men, some of whom were afflicted with gonorrheal rheumatism, acute Neisserian urethritis, etc. while others showed gross manifestations of syphilis.

## CONCLUSIONS

1. From the analysis of 20,000 cases of adult males, substantial congenital deformities were noted once in each 268 men.
2. The group of 5000 negroes presented one anomaly in each 277, while the 15,000 whites showed one in every 395 individuals, thus showing a predominance of defects among the negroes.
3. Among the latter the predominating deformity was polydactylism, the feet and hands being involved an equal number of times.
4. The prevailing deformity among the whites was syndactylism, the feet being represented most frequently. Among the whites defects of the body were seen more often than defects of the extremities; the contrary was the rule among the negroes.
5. Sixteen and a quarter of one percent of the deformities involving the extremities were right-sided, involving either the right arm or the right leg; 21.5 per cent were left-sided; while both extremities at once were involved in 26.5 per cent. Deformities of the trunk occurred in 35.8 per cent of the cases.

PLATE I



PLATE II



Fig. 16



PLATE III



FIG. 17

FIG. 18

FIG. 19

PLATE IV



PLATE V



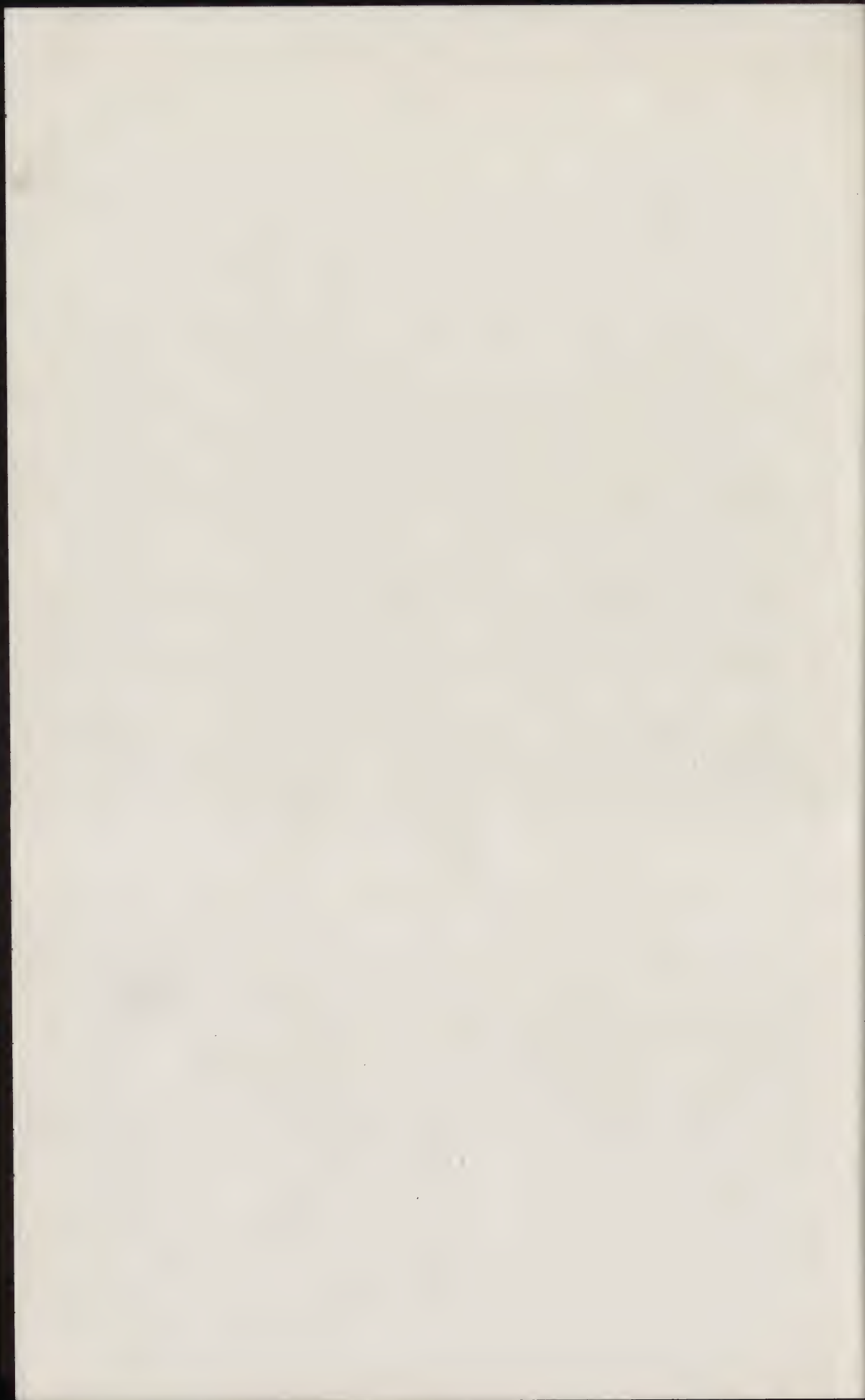


PLATE VI



PLATE VII







## SPECIAL COMMUNICATIONS

### ÉCOLE ET LABORATOIRE D' ANTHROPOLOGIE, PARIS

Extract from letter of Prof. L. Manouvrier to the editor, Paris, June 19, '21

"Je dois vous signaler une petite erreur historique consistant à attribuer un rôle en Anthropométrie à l'École d'Anthropologie. Ce rôle appartient exclusivement au Laboratoire d'Anthropologie de l'*École des Hautes Études*—plus ancien que l'École d'Anthropologie et n'ayant aucun lien avec celle—ce qui ne s'est jamais occupée d'Anthropométrie ni d'autres recherches, étant simplement une École d'enseignement libre et public de vulgarisation.

Le Laboratoire, au contraire, est un Etablissement d'État (officiel), dont le personnel est nommé et appointé par l'État. Il fait partie d'un ensemble de laboratoires officiels de recherches ayant pour but l'avancement de la science et disséminé dans l'Université sous la désignation d'*École Pratique des Hautes-Études*. Il y a de ces laboratoires à la Sorbonne, au Collège de France, au Muséum national d'Histoire Naturelle, etc. (Mécanique, Physique, Chimie, Biologie etc.)

Puisque vous êtes devenu un historien de l'Anthropologie, quelques précisions à ce sujet vous seront, je suppose, agréables.

Broca, qui était Professeur à la Faculté de Médecine fonda le Laboratoire d'Anthropologie dans le Bâtiment où il est encore. Et son laboratoire fut classé dans l'École des Hautes Etudes. (1871)

Il avait fondé depuis longtemps (1859) la *Société d'Anthropologie* et il obtint pour cette Société un local voisin du Laboratoire.

Lorsqu'il fonda en 1876, L'*École* d'Anthropologie, il obtint également pour celle-ci l'*hospitalité* dans ce même bâtiment de la Faculté de Médecine.

Les 3 établissements anthropologiques furent ainsi logés dans la même Maison mais en conservant chacun son indépendance et sa nature propre.

Personnellement, j'appartiens aux 3 établissements, étant secrétaire général de la Société et Professeur à l'École d'A. Mais ma situation officielle est celle de Directeur du Laboratoire après avoir été Directeur Adjoint et jadis, préparateur.

Broca m'avait confié la direction des travaux d'Anthropométrie et de crâniologie et je m'appliquai surtout à obtenir dans la pratique une précision sévère qui n'existait pas. Je succédais à Hamy qui eut la chance de trouver au Muséum, une place beaucoup plus avantageuse au Laboratoire d'Anthropologie du Prof. de Quatrefages auquel il succéda plus tard.

A l'École des Hautes Études les appointements sont très faibles, étant considérés comme supplémentaires. Mais pour l'Anthropologie la situation était une sorte d'apostolat presque monacal que j'ai exercé à mes dépens jusqu'au jour où le grand physiologiste Marey me proposa une place dans son Laboratoire du Collège de France à la Station Physiologique—de sorte que ma principale situation actuelle au point de vue du traitement est celle de S- Directeur de ce Laboratoire du Collège de France. Mais ce Collège de France ne possède pas de chaire pour l'Anthropologie—sur 42 chaires!"

#### INSTITUT INTERNATIONAL D' ANTHROPOLOGIE

At the first session of the Institut International d'Anthropologie, held at Liège, July 25-Aug. 1, 1921, Prince Bonaparte was elected President, Comte Béguen, Dr. Capitan and Dr. Papillault, Secretaries, and Dr. Weisgerber, Treasurer. National offices of the Institute were organized in Belgium (Pres. Max Lohest), Czechoslovakia (Pres. J. Matiegka), Italy (Pres. G. Sergi), Spain (Pres. Anton y Ferrandiz), Poland (Pres. K. Stolyhwo) and Argentina (Pres. A. Gallardo). Two prizes were founded under or in connection with the Institute: the *Prix hollandais*, instituted by Dr. Kleiweg of Zwaan, consisting of the percentage of a capital of 10,000 florins and to be awarded every three years for especially meritorious work or publication in Physical Anthropology or Prehistory; and the *Prix d'Ault du Mesnil* to the amount of the percentage of 10,000 francs to be given every three years for the best manuscript on Prehistoric Anthropology as determined by a jury. The Transactions of the session are published in the Sept.-Dec. number of the *Revue Anthropologique* (1921, XXXI, 261-498). They contain the following papers of direct interest to Physical Anthropology: Ledent (Réné)—De l'unification internationale des unités de mesures anthropométriques, 324-326; Dufestel (L.)—De la nécessité d'unifier les mensurations anthropométriques, 326-329; Godin (Paul)—Étude des caractères morphologiques et fonctionnels, révélant la capacité vitale et la capacité professionnelle aux divers âges, dans les deux sexes et dans les différentes races, 329-331; Matiegka (J.)—La capacité de travail du

corps humain, 331-333; Matiegka (J.)—L'Age dentaire comme signe du développement total, 333-335; Matiegka (J.)—Unification des mesures anthropométriques sur le vivant, 336; Vervaeck ( )—La circonférence horizontale maximum du crane sur le vivant, 337-342; Vervaeck—Toise combinée pour la détermination du buste, de la hauteur du crâne, de la glabelle, de l'implantation des oreilles dans les diamètres vertical et antéro-postérieur et des points de repère importants de la face, 342-343; Kleiweg ( )—Sur le travail des offices nationaux, 343-345; Sergi (G.)—Caractères distinctifs des races humaines, 345-346; Faure (Maurice)—Méthode de reconstitution des races préhistoriques, 346-351.

#### ANTHROPOLOGY IN THE PACIFIC

The *Proceedings* of the First Pan-Pacific Conference, held at Hawaii, August 2-20, 1920 (publ. 1921), show the following resolutions to have been adopted in relation to Anthropology (all branches):

"1. *Need for Polynesian Research.* Recognizing the necessity for the immediate prosecution of anthropological research in Polynesia, this conference calls the attention of Governments, patrons of research and research foundations to this important scientific need, and

*Recommends* That the most prompt and efficient steps be taken to record the data necessary to the understanding of man's development in the Pacific area.

2. *Facilities for Instruction and Research in Anthropology.* Since there is urgent need both for anthropological research and the training of men and women therefor, and since experience has shown the advantage of close association between the graduate departments of universities and persons and institutions carrying on anthropological investigations, this Conference

*Recommends* that centres be created for the study of anthropology and original research therein, such centres to be developed by the expansion of university departments or the alliance of universities with other research institutions with the result that these schools of anthropology shall combine all the essential features of a museum, a research staff and a graduate school. And further because of the peculiar conditions under which anthropological data must be gathered, necessitating both intensive field work in circumscribed areas extending over several years, and intensive synthetic work by men who are masters in many fields, thus requiring a number of men through a period of



years, we therefore recommend the establishment of research fellowships in Polynesian anthropology, such endowments being provided that these fellowships will attract the best men available and provide for uninterrupted work during an adequate number of years."

#### THE AMERICAN SCHOOL IN FRANCE OF PREHISTORIC STUDIES

##### HISTORY

In 1919 Dr. Henri Martin once President of the Société Préhistorique Française, allotted for an indefinite period a tract of ground to American anthropologists for the purposes of prehistoric excavation; the allotment, save for the title, is a gift and it was the wish of the donor that a school should be established by Americans in connection with the excavations where the students should have the opportunity of the study, classification and disposition of specimens.

The site is contiguous to the Mousterian Station of La Quina exploited for more than fifteen years by Dr. Martin and seemingly inexhaustible; it is near the town of Villebois-Lavalette, about twenty-five miles southeast of Angoulême (Charente).

Such a School has now been established under the joint auspices of the Archaeological Institute of America and of the American Anthropological Association; the original idea of Dr. Martin has been amplified, with the result that work has begun and will be carried on, following somewhat the same lines as that accomplished by the American Schools at Athens and Jerusalem.

The money necessary for the first year's work was raised by subscription, a Governing Board of nine members was elected and Professor George Grant MacCurdy of Yale University was appointed Director for one year from July first 1921.

Excavations began the first week in July, and during two-months of work, a very fair result in specimens of the upper palaeolithic epochs was attained; most of these are Mousterian as the site accorded the School by Dr. Henri Martin belongs to that culture.

##### PLANS FOR THE SECOND YEAR 1922-1923

The activities of the School may be divided into work in the field and work in the museum and lecture halls of Paris, and the former may be said to include both excavation and excursions.

##### EXCAVATIONS

Beginning July 1, 1922, it is hoped to spend three months in excavation; the result in numbers of specimens is of less importance than the training in excavation and in the study of specimens that will be the duty and the privilege of the students.

All the digging is done by the students and Director themselves; the technique of excavating a rock-shelter is different from that of all classical excavations, and from that of prehistoric sites in the open,

and even from the methods of clearing out a prehistoric cavern; as always, the utmost rigorousness of observation and control is expected of the Director and he in turn will require it of those under him.

The study, classification, cleaning and mending, comparison and exposition of the specimens found will be taught; in doing this full advantage will be taken of the advice, lectures and facilities of Dr. Henri-Martin. He has established on the ground a laboratory, complete in stone and bone collections of the Mousterian epoch, and containing a synoptic collection of neolithic and palaeolithic France.

The founder of this laboratory is most anxious in his kindly interest, to help us by precept and example.

The specimens that are likely to be found are flint Mousterian points, scrapers, and knives, and bones of contemporary animals, many of which bear marks of the flint implements used in battering and cutting. The most common animals represented are the bison, horse, reindeer, stag; besides the hyena, lion, fox, wolf and wild boar. A few hundred feet away a fragment of mammoth tusk was discovered; human remains have also been found at La Quina, and there is always the chance that traces of Neanderthal man may be found.

Other sites of later palaeolithic man abound in the neighborhood and it is hoped that it may even be possible to use part of the autumn in excavating a Gallo-Roman tumulus in Southern France.

#### EXCURSIONS

It is of the highest importance that trips be made to the classical centre of Les Eyzies, whence the famous caves of Font de Gaume and Combarelles, as well as the rock-shelters of La Ferracie, Le Moustier, La Madeleine, Laugeries Haute and Basse, and many others may be visited.

With good fortune it may be that Professor Capitan, Mr. Peyrony, the Abbé Breuil, and others whose names are intimately connected with these sites will be on the ground; in this case, judging from the universal rule of French scientific hospitality, it may be promised that the visit will be doubly interesting.

A trip to the Pyrenees will be arranged and it may be that Count Bégouen will again introduce the students to the wonders of the bisons of Tuc d'Audubert and the Sorcerer of Trois Frères.

Mas d'Azil, Gargas and other Pyrenean caves must be seen; the detailed itinerary of course will depend on weather, time and finance. In the spring trips will be made to Brittany, where the megalithic monuments, especially the alignments near Carnac will be studied, to some fortified camps, such as the beautiful Camp de Cesar near Dieppe, and to Alesia or some important Gallo-Roman site.

#### INDOOR WORK—MUSEUMS AND LECTURES

In and around Paris are the Muséum d'Histoire Naturelle, the Muséum de Paléontologie Humaine, the Trocadéro Museum, and the great Musée des Antiquités Nationales at Saint-Germain-en-Laye. The

students will be expected to familiarize themselves with the prehistoric sections of these, and under the supervision of the Director, to specialize on some particular subject and write a thesis connected with it.

There will be museum walks and lectures by the Director, but the main part of the instruction will come from attendance at the lectures of the *École d'Anthropologie de Paris* and of the other institutions in anthropology of the city.

These are generously opened to the public freely, and the chance of hearing and of knowing personally the men who have made the French School and the museums famous, must be appreciated by the students; the names of Capitan, de Mortillet, Hervé, and Manouvrier at once suggest themselves.

In comparative art, the collections in the Egyptian section of the Louvre, and paintings in the Luxembourg and especially in expositions of realistic modern art must be visited; an appreciation of the place in the history of art of the palaeolithic and neolithic paintings, engravings and carvings can not be gained without some knowledge of the history of technique through the years of history.

#### REQUIREMENTS

Students may be admitted for the summer months; they will get the advantage of the field work and of some of the excursions. Students classified as "regular" should enter for the whole period of twelve months; these will receive a certificate testifying to the amount and the quality of work done, and will be required to present a thesis showing at least the faculty of independent observation.

For summer students no special experience in prehistoric archaeology is indispensable though a short course of general reading and some visits to museums of prehistoric archaeology are highly desirable. These will vary in the individual cases; those who have any idea of attending should write to the Chairman who will advise them as to what is most feasible and desirable. Nor, for summer students, is an extended knowledge of French absolutely necessary; a few weeks on the ground and the physical necessity of speaking French in daily life will marvelously increase the students' vocabulary.

For "regular" students, some knowledge of prehistoric archaeology, and of elementary anthropology is desirable; those who intend entering should write to the Chairman giving their experience and attainments.

Some knowledge of French is here almost indispensable, though with diligent study during the summer and the Director's aid the deficiency could be made up in part.

#### FINANCES

The lectures and all the privileges of the School are free, but the students pay their own expenses.

It may be said that the minimum allowance for living in France is twenty to twenty-five francs a day.



There will be a very few opportunities for earning money at the excavations by doing some of the physical labor for which otherwise local workmen would have to be engaged.

In Paris, there are chances of earning money, but, as always, the time and energy put on outside duties hamper the best intensive work.

#### SCHOLARSHIPS

Two scholarships, one of five thousand and one of two thousand francs are offered for 1922-1923; these will be awarded by competition; applicants should address the Chairman as soon as possible giving the fullest information about themselves.

Applicant should have some knowledge of prehistoric archaeology, not necessarily in the European field, and some acquaintance with French; a long course of preparation is not absolutely necessary.

The work of the School begins July first of each year, and continues for one year.

The time is divided between excavations, excursions and study in museums. This is supplemented by attendance at lectures given by French scholars and by the American Director.

Those who consider entering the school, whether or not applicants for scholarships, and whether or not intending to pass the entire year in the School, should address the chairman as soon as possible.

#### GENERAL

Students of both sexes are admitted.

Accommodations near the excavations, while not luxurious, are readily supportable, and the reasonable comfort and well-being of the men and women is looked out for.

#### CHARLES PEABODY

Chairman

Peabody Museum

Cambridge, Massachusetts

#### CHILD WELFARE IN BELGIUM

Through the second International Conference on the Protection of Childhood, held at Brussels from July 18 to July 21, the attention of the world has been called to the program Belgium is working out for the conservation of childhood. Of timely interest is an article by Dr. Rene Sand of the University of Brussels, recently received by the U. S. Department of Labor through the Children's Bureau. How intelligence, determination, and united effort triumph over conquest, war, and famine is vividly portrayed in this discussion of "Industrial Medical Reconstruction in Belgium," which appeared in "Living Medicine."

Even during the years of occupation, when the government had left the Belgian soil and the only central coordinating agency was the voluntary "Comité National," public-health activities were started on a hitherto unknown scale, and for the first two years there was an actual

decline in infant mortality. Dr. Sand accounts for this in part by the cessation of industrial work for women. The Children's Welfare League, which had begun to function to a limited extent before the war, developed in the midst of the most difficult circumstances until even the smallest village was reached.

In spite of these efforts, the average child was, at the time of the Armistice, one full year backward in normal development; the weight of the average Brussels school boy was three pounds below normal, and of the average school girl, seven pounds.

The first step in the medical reconstruction of industry was the establishment of an independent Labor Medical Service, which includes in its functions the protection of expectant and nursing working women and the care of the health of working children. The service immediately formulated a constructive program which enlisted the cooperation of all agencies concerned in the promotion of public health, including the health of working mothers and their children.

In the United States, 18 States provide for the physical examination of every child entering industry, but no State has provided for examinations of working children at regular intervals. Belgium has adopted the advanced program of a medical examination for every juvenile not later than a month after he has entered an industrial occupation, to be repeated once a year until the child reaches 18, and oftener in case of disease.

Belgium has realized that health protection in the community must go hand in hand with health protection in industry, and Dr. Sand emphasizes the following points: General public health work; child welfare; housing; the restriction of alcohol consumption; and education and recreation, both for adults and children.

A national children's board has been established, which is maintained by public and private funds, and which supervises and supports child welfare organizations meeting certain conditions. The child welfare program includes the periodical free examination of children under three years of age brought by their mothers for examination; the establishment of free medical dispensaries for expectant mothers; the diffusion of knowledge relating to infant health and maternal nursing; and the supervision of boarded-out children under seven years of age. The cost of child welfare work will be borne one-half by the state, one-fourth by the province, and one-fourth by the municipality. Provincial and municipal boards are appointed by the national board, and advisory committees are provided for.

U. S. CHILDREN'S BUREAU

## LITERATURE

### GENERAL

HOMO. By Mendes-Corrêa (A. A.)-12 mo, Lisboa, 1921, 317 pp.

The author endeavors to give Portuguese literature a satisfactory account of the results of modern studies relating to the origin of man; in which connection he also gives numerous data on man both ancient and present in Portugal, which are of wider interest to anthropology.

The author believes in "neomonogenism," and leans to a sensible theory of evolution. As to *Pithecanthropus*, he with some other modern authors, regards the skull and teeth as those of an intermediate being between apes and man, while the femur is human.

Among the conclusions of his book the author points out that, despite the great mass of information already gathered, much still remains to do in the way of clearing up the problem of human origin. He exposes the conjectural and greatly debated points of view put forward with regard to the nature of human ancestors, their number, the number and situation of the centres of origin and diffusion of the *Hominidae*, the mechanism and date of anthropogenesis, etc.; and ends by affirming his faith in the value of the contributions which Paleontology will continue to furnish for the clearing up of this subject.

PRINCIPLES AND METHODS OF PHYSICAL ANTHROPOLOGY. By Sarat Chandra Roy.—8°, Patna, India, 1920, 181 pp.

A creditable though not at some points fully up-to-date effort, intended evidently for the benefit of native workers in India. The book represents a course of lectures delivered by the author in the Patna University in 1920. The six chapters, relating to so many lectures, deal with the following subjects: (1) The Scope, Division and Methods of Anthropology and Man's Place in Nature; (2) The Antiquity of Man; (3) The Evolution Theory; (4) The Evolution Theory as Applied to Man; (5) Man's First Home and Early Migrations; (6) Evolution of the Human Races and Their Classification.

The writer has read extensively, and incurs the common reader's penalty of quoting some opinions which are no more acceptable. But for India the book will serve as a good basis on which to proceed.

MORRIS'S HUMAN ANATOMY. Edit. by Jackson (C.M.), 6th ed., Phila., 1921, 1 vol. 8°, 1507 pp. 1164 ill's (of which 515 colored). (P. Blakiston's Son & Co. Phila., \$10 net.)

A good text book of Anatomy—so far as it goes; which is not any further than most such text books. Their most serious defect, outside of antiquation in references, is the keeping away from the student of the very results of modern research which would give life and interest to



his studies, the results namely relating to variation. The time has about come when the medical student should be given an Anatomy containing all the established somatological facts, which will open to him new horizons and make him think instead of mere cramming; but such a text book can and should no more be written or even edited by a single man; it will need a corps of expert specialists in the various subdivisions of Anatomy.

COMMONSENSE IN RACIAL PROBLEMS. By Bateson (W.)—*Eug. Rev.*, 1921, XIII, No. 1, 325-338.

In his Galton Lecture before the London Eugenics Educational Society, Professor Bateson discusses with his usual light sarcasm and some pessimism, the eugenic problems in connection with the English people and humanity in general. Witnessing, as the observer does, "every day of his life the consequences of the working of the laws of heredity, the knowledge that the destinies of mankind are governed by the same laws is to him an all-pervading truth. . . .

"The truth which the eugenicist is urging upon a reluctant and unheeding world is in essence this: that the physiological fact of the diversity of mankind is of prime importance in every consideration of human affairs; that all measures for the regulation of public or private conduct which ignore this fundamental fact are entered upon in defiance of common sense, and that the consequences of such defiance are stupendous, and far-reaching to a degree that can as yet be only dimly estimated. Those who have comprehended and realised this manifest truth plead further that since the diversity of type is certainly transmitted to posterity according to fixed and ascertainable rules, it behooves the human race to make the phenomena of heredity and racial physiology the object of zealous study. The question at issue is whether the facts of physiology are to be ignored or to be accepted as the common ground from which conduct is to be directed. At the present time for the statesmen in whose hands the destinies of the world still remain, the facts of nature do not exist. Men are not animals, propagated according to physiological systems, fixed like those of Chemistry or Astronomy, but voters, and how voters are propagated, with what consequence to themselves or to the succeeding generations it is superfluous to ask or consider. . . .

"Two entirely different aspects of eugenic policy are to be distinguished. The one is personal, the other public. . . . The outstanding lesson taught by eugenic education is that the changes which must inevitably follow on every considerable interference in the distribution of wealth and of opportunity are ultimately racial. Neither custom nor law can be changed materially without introducing a discriminating influence on the prospects of the several varieties of which society is composed, and the more fully the extreme congenital diversity of the several types is realised, the more will the magnitude and extent of these racial effects become apparent. . . . Man is from the naturalist's point of view a domesticated and most variable animal, and to make

a domestic species, recently derived from various stocks, into a breed of equal and similar individuals is only possible in the peculiar and highly special circumstances which the fancier can provide. We are a heterogeneous group of dissimilar beings, and it is time that the greatness of this dissimilarity were brought home to all civilized communities. No one perhaps at this time would venture to assert that men are born equal, but few realize *how* unequal they are. . . . There are plenty of ways in which common sense might be applied to racial problems. That we shall see any such application in our own country seems to me in a high degree unlikely. But we are not the only nation in the world, and a competitor may not improbably learn from us, appropriate our discoveries, and enter into our labours. The consequences of bringing biological knowledge to bear on composition of society must be enormous, rapidly accomplishing aims of a magnitude that statesmen perhaps have never conceived. Our own concern in these developments will probably be that of spectators. . . . Our immediate posterity will learn something of the consequences of un-applied biology."

THE TREND OF THE RACE. By Holmes, (Samuel J.)—8°, N. Y. (Harcourt, Brace & Co.), 1921. 396 pp.

The author, well-known professor of Zoology in the University of California, tells us, "The present volume is the outgrowth of a course of lectures on Eugenics which has been given for several years in the University of California. Its aim is to present an account of the various forces which are at present modifying the inherited qualities of civilized mankind."

The bibliography—though numerous references are given—is to be published in another volume.

The contents of this volume cover the following topics: "An introductory Orientation; The Hereditary Basis; The Inheritance of Mental Defects and Disease; The Heritable Basis of Crime and Delinquency; The Inheritance of Mental Ability; the Decline of the Birth Rate; The causes of the Decline of the Birth Rate; Natural Selection in Man; The Selective Influence of War; Sexual Selection and Assortative Mating; Consanguineous Marriages and Miscegenation; The Possible Rôle of Alcohol and Disease in Causing Hereditary Defects; The Alleged influence of Order of Birth and Age of Parents upon Offspring; the Racial Influence of Industrial Development; The Selective Function of Religion; Retrospect and Prospect."

A serious, careful work, of a plainly higher than average standard, in which the author has endeavored to give due consideration to all manifestations that appear to be affecting the race, whether favorably or unfavorably. The task of course is one for a superman, or at least for a man of the future, when our statistics and data shall have reached a more definite value than they now possess.

The conclusions are largely tentative. The author believes that "Our available data on the recent changes which have occurred in the physical or mental characteristics of the race, are . . . insufficient to

afford any positive proof of decadence. Even if rather extensive changes had taken place it is doubtful if the fact could be established by the kind of records which have been compiled. We can only judge of the present trend of our biological development by a study of the forces which are now producing modifications in the inherited qualities of mankind. In our study of these forces it has been found that some of them are working in the direction of racial improvement, while others are quite evidently having an opposed influence. What the resultant effect will be can be determined only by some estimate of their relative potency. . . . The one agency which appears to be most clearly working toward racial improvement is natural selection. . . . When we attempt to gain a comprehensive view of the forces which are changing human inheritance it becomes apparent that the forces which have been called into action as a result of the development of our culture are in large part racially destructive. We cannot say that they are entirely so, because there are counter tendencies which sometimes arise. All those agencies which bring about the present well marked correlation between sterility and success in life tend to rob the race of its best inheritance. It is chiefly the primitive evolutionary factors which operate among the lower animals that are making for racial improvement in man."

As to remedial or eugenic measures, the author naturally favors proper birth restriction, also proper enlightenment. "The race has its fate in its own hands to make or to mar"; but it is difficult to make it obey the indications.

WESEN UND ENTSTEHUNG DER RASSENMERKMALE. By Paulsen (J.)—*Arch. f. Anthropol.*, 1920, XVIII, 60-70.

An attempt to explain individual as well as racial differences in man on the basis of the action of the endocrine glands. Various observations and hypotheses are forced into serving as "proofs" for this (not new) theory. The paper contains no original research.

A. H. SCHULTZ.

RASSE, RASSENMISCHUNG UND KONSTITUTION. By Schlaginhaufen, (O.)—*Natur und Mensch*, 1921, No. 11, 398-411.

The author has gathered together our scattered scanty knowledge on the relation of anthropological data to constitution, especially disposition and immunity in regard to certain diseases. He points out that in such investigations more attention should be paid to the age of the material examined. The question as to whether hybridization produces new qualities of constitution is discussed and is answered in a positive sense. However, different race-crossings may produce different changes in constitution. The important studies by Lundborg on the relation of racial intermixture to tuberculosis are considered at length.

A. H. SCHULTZ.

MAN IN THE PACIFIC. By Wissler (Clark)—*Proc. I Pan-Pacif. Sc. Conf.*, 1921, I, 53-59.

Paper of a general and introductory nature calling attention to the anthropological problems of the Pacific.



## EVOLUTION MAN'S ORIGIN EARLY MAN

DIE ABSTAMMUNG DES MENSCHEN. By Mollison (Th.)—*Die Naturwissenschaften*, 1921, IX, H. 8, 128-140.

A good semi-popular account of man's derivation and evolution according to present knowledge, by one of the present leaders of anthropological research and thought in Germany. The author stands firmly for the view that the Pithecanthropus represents not a great gibbon but a being far advanced in the direction of man, though not necessarily man's direct ancestor. The Piltdown find, he is inclined to believe, comprises the jaw of a Tertiary ape, with a skull cap of *Homo sapiens* of a late diluvial if not post-diluvial derivation. The teeth from the Böhmerwald of the Swabian Alb are ape teeth, not human. The *Homo sapiens* species has probably been derived from that of, or one similar to, the *H. primigenius*, though evidently this has not taken place in western Europe. Finally, Dr. Mollison places himself unequivocally against all ideas of human polygenism; man throughout shows so much in common that he could only have been derived at one time, in one locality and from one brand of Primates.

DER JAVA-TRINIL-FUND "PITHECANTHROPUS."—Können die Eoanthropos and Pithecanthropos Funde uns zuverlässige Aufschlüsse über für Anthropogenese geben? By Ramström (Martin)—*Upsala Läkareförs. förhandl.*, 1921, XXVI, H. 5-6, sep. 37 pp.

Renewed morphological studies relating to the remains of the Pithecanthropus lead the author to the following conclusions:

Neither "Eoanthropus" nor "Pithecanthropus" are capable of giving us any reliable conclusions as to anthropogenesis. The Trinil fossils proceed from the Quaternary or Diluvial period and not from the Tertiary. The same strata that yielded the Pithecanthropus remains gave also fossil remains of apes; and there were found in Java fossil remains of man of at least the same age as those of the Pithecanthropus.

The formation of the skullcap of the Pithecanthropus find has shown itself in all important respects to be that of a chimpanzee, and though it had attained unusual and not hitherto witnessed dimensions this circumstance is not capable of substantiating the notion that the skull represents a transitory form between the apes and man. The femur is wholly human and resembles most that of the Aurignacian man, showing none of the features characteristic of femora in the anthropoids and especially in the chimpanzee, in consequence of which the assumption of a transitional form between the apes and man must be dismissed as unfounded. So far as the author can see then, it follows that the association of the wholly chimpanzee-like cranium with the entirely human (Aurignacian) femur may be regarded as unwarranted.

As to the Piltdown find, conditions are reversed: the skull is human (Aurignacian); the jaw that of a chimpanzee. "Aurignacian" man probably originated in the Far East.

All of which is interesting, though not yet convincing.

LE CRÂNE ET LA MACHOIRE DE PILTDOWN. By Boule (M.)—*L'Anthrop.*, 1920, XXX, Nos. 3-4, 394.

Professor Boule states here unequivocally his opinion that the Pilt-down jaw is that of a chimpanzee, while the skull belongs to actual Man. It is difficult to determine the exact age of the skull fragments, for the quite superficial layer in which they lay may have been more than once disturbed.

UN CRÂNE D'ENFANT NÉANDERTHALIEN PROVENANT DU GISEMENT DE LA QUINA. By Martin (Henri)—*L'Anthrop.*, 1921, XXXI, Nos. 3-4, 331-4.

A brief report, with two good illustrations, on a highly interesting immature skull found in the Mousterian deposits of La Quina. The skull is that of a child of about 8 years of age. It is the first known juvenile skull of early man in a fair state of preservation, and shows already a series of primitive characteristics identifying it with the neanderthal phase. Detailed description will doubtless follow.

SUR LA RÉPARTITION DES OSSEMENTS HUMAINS DANS LE GISEMENT DE LA QUINA. By Martin (Henri)—*L'Anthrop.*, 1921, XXXI, Nos. 3-4, 340-345.

During fourteen years, assiduous exploration in the deposits of La Quina yields every year, aside of archeological specimens, parts of human skeletons, all of which bear more or less the impress of the Neanderthal type. The phase, as shown by the deposits, was of long duration.

Abbé Breuil, following Dr. Martin, contrasts the dispersed state of the La Quina remains with the indubitably intentional burials of Mousterian age at La Ferassie.

DIE MENSCHLICHEN SKELETRESTE AUS DEM KÄMPFE'SCHEN BRUCH IM TRAVERTIN VON EHRINGSDORF BEI WEIMAR. By Virchow, (H.)—Jena, 1920, 141 pp., 42 ill., 8 pl.

In 1914 a human mandible was found in a limestone quarry in Ehringsdorf near Weimar, Germany. In 1916 a second mandible and a few other parts of one skeleton were discovered in the same quarry. The first mandible is that of an adult and most probably female; the left ramus is entirely missing and the right partly destroyed. The second mandible belonged to a child of approximately 10 years of age; nearly all the right half is lacking. The author describes these findings, which he places definitely as belonging to the Neanderthal race, in a large and detailed monograph. The first part of his work deals with the bone of the lower jaw, the second part with the teeth.

The relief of the teeth, especially of the incisors, canines, and first premolars, shows a striking resemblance to that of the corresponding teeth of the jaws from Krapina and Le Moustier. The ramus mandibulae coincides in most points with the ramus of other early palaeolithic jaws. Its marked outward trend is similar to that of La Chapelle-aux-Saints. The horizontal curve of the mandible of Ehringsdorf is rather

long and narrow. A vertical section through the symphysis shows an unusual thickness of the alveolar portion in this region, the great receding of the chin, and the surprisingly small angle between the planum alveolare and the alveolar horizon.

The interesting discussions of the various tubercles, foramina, fossae, lineae, sulci, etc. of the jaw do not lend themselves for condensation in a brief review. The critical treatment of the numerous theories regarding the development of the region of the chin and the ossicula mentalia may be especially mentioned.

A. H. SCHULTZ.

(DILUVIAL MAN OF OBERCASSEL.) Verworn, Bonnet & Steinmann: DER DILUVIALE MENSCHENFUND VON OBERCASSEL BEI BONN. Fol., Wiesbaden, 1919, 193 pp., 28 pl., 42 fig. Review with original notes by E. Fischer. *Z. f. Morph. & Anthrop.*, 1920, XXI, H. 3, 431-441.

The original work describes two skeletons, a male and a female, found in 1914 in late diluvial (Magdalenian) deposits in Obercassel, near Bonn, on the Rhine. The two are of similar type, represent in the main modern man, but show still certain affinities with the *H. neanderthalensis*.

The reviewer believes the crania show much likeness to skulls of Eskimo. The Eskimo illusion, raised originally by the Chancellade skull, has evidently still a considerable attraction in Europe. Probably a more rational explanation of the resemblances, which may well be conceded though both the Chancellade and the Obercassel specimens show also important differences from this type, is that in both the Eskimo and these various crania they have been produced by similarities by functional nature, especially those involving a great development of the muscles of mastication. On this basis there would be no objection to describing such skulls or some of their features as "Eskimo-like"; but generally the terms used are such as to make possible an implication of the identity of the European specimens with the Eskimo; in other words, a racial identity, which from an Americanist point of view would be quite an enormity.

(EXPLORATIONS IN THE CAVES OF THE KRAKOW-WIELUN HILLS in 1914.) By Krukowski (Stefan)—*Archiv Nauk Antropologicznych*, Lwow-Warszawa, 1921, I, No. 1; repr. 8 pp., 2 pl. (Polish).

A brief report on the exploration of a series of caves several of which gave indications of the presence of prehistoric (Acheulean to Neolithic) man. No skeletal remains came as yet to light.

SOME EARLY NEANTHROPIC TYPES IN EUROPE AND THEIR MODERN REPRESENTATIVES. By Fleure (H.J.)—*J. Anthrop. Inst.*, 1920, L, No. 1, 12-40.

"In this paper the attempt has been made to study, both morphologically and geographically, a group of associated characters. It is found that they occur on the Plynlymon moorland and elsewhere in Wales, in Ireland, in France, in the Iberian peninsula, in Sardinia, in North and East Africa, among the Australians, in Fiji and in East



Brazil. The other characters associated with them may and do, vary considerably from region to region. These characters are shown to have occurred among Palaeolithic men and the view is taken that we are dealing, in the modern populations, with survivals of a group of characters of high antiquity among peoples whose other characters vary too much for us to be able to speak of a common type. The possibility of some characters being outward and visible effects of changes of internal secretions and the like is borne in mind, but no speculations on this point are ventured. They would be irrelevant here. . . .

"Granting the occurrence of a fairly early post-glacial spread of long-headed men, in all probability of several varieties, including "Combe Capelle," "Cro-Magnon" and others, we are able to picture to some extent the further evolution of characters in certain regions. The Baltic and West Mediterranean are chosen for special consideration because what are considered to be distinctive racial or sub-racial types are associated with these regions. The thought is pursued in this paper that the types in question show certain characters, evoked in the long run by environmental considerations, modifying various early forms of long-headedness and associated characters. The skulls, probably of Aurignacean date, are grouped together with the Grimaldi Africanoid as a variant. The Cro-Magnon skulls and one skull from the Grotte des Enfants (Grimaldi) are probably another type. The Barma Grande (Aurig.) and Obercassel (Magd.) skulls suggest mosaics of these two groups. The Chancelade suggests intensification of some of our grouped characters and modification of others.

Skulls from Laugerie Basse, Sorde, Placard and Bruniquel, all Magdalenian or later, suggest modifications from our grouped characters towards the Mediterranean type, while several of the skulls from Solutré tend towards the Nordic type.

Skulls of dates undoubtedly later than the Palaeolithic are discussed in so far as they suggest survival of the grouped characters.

Britain, as a region of refuge lying off the zone intermediate in position and in character between the Nordic and West Mediterranean areas of Characterization, is supposed to show amongst its long-heads:

(a) Survivals of the old characters—"Combe Capelle" and probably Cro-Magnon, etc.; (b) Nordic immigrants; (c) Mediterranean immigrants; (d) Survivals of individuals who have not definite Nord or Mediterranean blood in their ancestry, but represent descendants of people evolving from the stage (a) above to stage (b) or possibly (c). This is of course, in addition to broad-headed elements."

The author's reflections on heredity in man call for documentation.

THE BROKEN HILL SKULL. By Woodward (A. Smith)—*The Illustr. Lond. News*, Nov. 19, 1921; *ibid.*, same title, by Keith (A.); also in *Nature*, *Discovery*, *Science* and various other periodicals.

Preliminary and incomplete accounts of a remarkably inferior skull discovered in a cave in Rhodesia. The specimen is "in a remarkably fresh state of preservation, not at all fossilised, and its substance appears

to differ from modern bone only in the loss of its animal matter. The condition alone is insufficient to decide whether it dates back to the Pleistocene period or whether it belongs to a recent century. The associated animal remains at any rate show that the man it represents lived in Rhodesia under circumstances that still existed in that country a few years ago when the white races first arrived there.

"The brain-case is that of a very ordinary man with bone not thicker than that in an average European, and of similar structure. The size of the brain cavity is not yet determined, but is clearly far above the lower human limit. When seen in side-view however, the skull has an extraordinary appearance, because the bones of the face are relatively very large, and the upper edges of the eye sockets are inflated into immense rounded crests, or ridges, which obscure the shape of the forehead and give it a retreating contour. The skull thus approaches that of a great ape, and when seen in front view its large, square orbits, with their overhanging ridges, recall those of a gorilla. As readily seen by comparing the photographs, the skull is indeed human, with reminiscences of an ape-like ancestor in its face. The bones of the nose are typically human, but their arrangement shows that it would be broad and flattened. . . .

"With the Rhodesian skull were found a complete shin bone (*tibia*) and the two ends of a thigh bone (*femur*) which are in all respects those of an ordinary modern man—totally different from the corresponding bones of the Neanderthal race found in France and Belgium. If these limb bones really belong to the associated skull, the Rhodesian cave man stood perfectly erect like ourselves, without the inelegant shoulders and the shuffling gait which must have been habitual in Neanderthal man.

"This reference of the limb bones to the skull is all the more probably correct, because a fragment of the upper jaw of a second individual found at the same time was preserved, and it undoubtedly belongs to the same kind of skull. A whole colony evidently inhabited the cave, and all the human remains found in the one layer of earth may be assigned to them without much hesitation."

Professor Keith, among other discussion, calls attention to the resemblance of the type of the new-found skull to that of the fossil cranium of Gibraltar.

The two articles in the *Ill. Lond. News* are provided with very good photographs of the specimen, in addition to which the number brings photographs and description of the cave and a very plausible attempt at reconstruction of the man represented by the specimen.

NEOLITHIC CAVE DEPOSIT AT SHA-KUO-T'UN, CHINA.—A rich deposit of human skeletal material and a large number of associated Neolithic artifacts have recently been discovered by Dr. J. G. Andersson, Mining Advisor to the Chinese Government, in a limestone cave at Sha-Kuo-T'un in Fengtien. In the subsequent work of excavation Dr. Andersson was assisted by Dr. Davidson Black of the Peking Union Medical

College. The character of the deposit indicates that the site was not an ancient burial place. The skeletal material was largely human, there being but relatively few remains of lower mammals except in the upper stratum of the deposit. No complete skeletons nor intact skulls were found. The richest finds of human material and artifacts were made in a deeply situated and quite sharply defined blackened stratum in which dissociated skeletal parts, for the most part fragmentary and in many cases charred, were scattered in the utmost confusion. The remains of more than a score of individuals of all ages and both sexes were recovered in this stratum which was overlaid by undisturbed cave loam to a depth of from 0.5 to 0.8 metres. A report on the topography of the cave and its locality with a description of the artifacts will be made by Dr. J. G. Andersson, and together with a report on the human skeletal remains by Dr. Davidson Black, will appear subsequently in the *Polaeontologica Sinica*.

D. B.

## ONTOGENY

A COLLECTION OF CHINESE EMBRYOS. By Stevenson (Paul H.)—*China Med. J.*, XXXV, No. 6, Nov. 1921; repr. 18 pp.

The collection of Chinese embryos and fetuses in the Anatomical Laboratory of the Peking Union Medical College, numbers now over 220 specimens. The present communication has for its object merely to call wider attention to the precious anthropological material, to stimulate further collection and to indicate the first lines of studies to which the specimens will be subjected.

THE GROWTH OF THE CENTRAL NERVOUS SYSTEM IN THE HUMAN FETUS AS EXPRESSED BY GRAPHIC AND EMPIRICAL FORMULAE. By Dunn (Halbert L.)—*J. Comp. Neur.*, Dec. 1921, XXXIII, 405-491.

The principal types of growth in the central nervous system of the human fetus have been obtained (1) by securing accurate data upon volumetric and linear determinations of the various portions of the central nervous system and (2) by statistical and graphic analysis of these data.

The material used in this study consisted of 156 human fetuses. They ranged from 3.1 to 53.6 cm. in total body length and were distributed so that at least one specimen was available for each centimeter interval. Practically all of these specimens were fixed in formalin.

The principal result of this work lies in the possibility of classification of the growth of the fetal central nervous system into 4 main sub types of growth, all of which are similar in character to the growth of the other viscera and of the major parts of the body in this period. These subtypes are:

1. The cerebral subtype, which is characterized by, (a) a steady and relatively slow increase in volume from the second to the beginning of the sixth fetal month and a constant and more rapid increase from this time to birth, and, (b) by a steady and constant growth in linear dimensions from the second fetal month.



2. The brain stem and cord subtype, which shows a much more rapid growth from the second to the end of the fifth fetal month than it does in the last five months of fetal life.

3. The cerebellum subtype, which proceeds very slowly from the second to the end of the fifth fetal month and then increases tremendously from the sixth month to birth.

4. The compound subtype, which represents the combined effect of two or three or all of the above varieties, predominated by the cerebral subtype.

An estimation of the proportions which the cerebrum, cerebellum, and the brain stem form of the encephalon at the various periods of fetal life offers a means of comparison of the relative growth of these parts. Those of the brain stem and the spinal cord are relatively high from the second to the fifth fetal month; that of the cerebellum is at its height in the last three fetal months; while that of the hemispheres reaches its maximum in the sixth fetal month.

H. L. D.

CRANEOMETRÍA DE UN FETO COMPARADO CON ADULTOS. By Aranzadi (T. de)—*Publ. Sec. Cienc. Nat.*, Barcelona, 1920, 77-87; with a résumé in French.

Comparisons of the various dimensions, indices and angles in a skull of a fetus at term with a male and a female skull of similar derivation. A superposition of the outlines of the three skulls shows various interesting differences; but the question is—how nearly may the fetal and the two unrelated adult skulls be regarded as of the same type. Only an average fetal skull of an unmixed population with average male and female skulls of the same would give reliable comparisons. But the method is a nice one and deserves to be tested on fetal and adult skulls of various racial groups.

CHANGES IN THE FORM AND DIMENSIONS OF THE CHEST AT BIRTH AND IN THE NEONATAL PERIOD. By Scammon (Richard E.) and William H. Rucker—*Am. J. Dis. Child.*, 1921, XXI, 552-564.

At birth and in the neonatal period the thorax undergoes a series of modifications in dimensions and form which may be summarized as follows:

Changes in the Thoracic Index at Birth and in the Neonatal Period.

Age	Number of Cases	AVERAGE OF INDICES	
		At the level of the Nipples	At the Level of the Tenth Rib
9th fetal month.....	18	86.5	92
10th fetal month.....	13	86.0	92
Birth (full term fetuses).....	19	86.0	91
15 minutes after birth.....	23	106.0	95
1st day (12 hours) after birth.....	23	102.0	92
3rd day after birth.....	23	102.0	89
5th day after birth.....	21	100.5	91
7th day after birth.....	18	102.0	91
10th and 12th days after birth.....	10	100.5	88

The horizontal chest circumference (at the nipples) is markedly increased at the first inspiration. In the first day, within twelve hours after birth, it enters a period of decrease which continues for two or three days and which is followed by a period of circumference increase. The initial circumference following the first inspiration is regained in the second week.

No data are available as to the changes in the circumference of the chest at the tenth rib with the establishment of respiration, although it is probable that they are somewhat similar to those at the nipples, although less extensive. After respiration is established, the circumference at the tenth rib undergoes, first, a decrease, and then an increase in a manner similar to that of the circumference at the level of the nipples.

The anteroposterior and the transverse diameters of the thorax, both at the level of the nipples and at the level of the tenth rib, show changes comparable with those of the circumferences at these levels. They decline in magnitude from the first to the fifth day after birth, and then enter a period of recovery, the initial dimensions (after respiration is established) being regained about the middle of the second post-natal week. The anteroposterior diameters undergo a much greater reduction than the transverse diameters.

The thoracic index at the nipples (Hrdlička) stands at about 86 before birth. With the establishment of respiration it rises to an average of 106 and then drops to about 102 in the first twenty-four hours. During the remainder of the neonatal period, it declines irregularly and slowly, being 100.5 in the middle of the second week. The changes in the thoracic index at the level of the tenth rib are of the same general character as those at the level of the nipples but are less pronounced.

The changes in the form and dimensions of the chest in the neonatal period (with the exception of the postnatal loss in circumference and diameter which seem to be associated with postnatal weight loss) are reflected in the order and degree of expansion of the different parts of the lungs.

THE PHYSICAL GROWTH OF CHILDREN FROM BIRTH TO MATURITY.  
By Baldwin (B. T.) *University of Iowa Studies in Child Welfare*, 1921.  
8 vo., 411 pp.

To anyone interested in human growth this book will be a welcome and valuable aid. The author contributes a wealth of new data gathered from observations on large series of infants and children and has collected and made use of over 900 references bearing on growth in man. To give some idea of the wide range of the contents of the book it may be well to enumerate some of the most interesting conclusions. Boys, on an average, double their birth weight at the end of the seventh month, and girls at the end of the eighth month. From 60 to 70 percent of the babies who are above the average weight at the beginning of the first year are still above average at the end of the year. Artificially fed babies, as a rule, weigh less than breast fed babies. From birth to six

years of age boys are uniformly taller than girls and heavier at all ages. The height doubles during the first six years of life and the weight increases four times. Boys are relatively heavier for their height than girls. As a rule, tall boys and tall girls reach their adolescent stature earlier than do short ones. Growth curves in weight, from 7 to 17 years of age, tend toward concavity; those in height, toward convexity. Sitting height standards are more satisfactory from an anthropometric point of view than those for standing height. Chest girth is relatively less in girls than in boys during the pre-adolescent period. Cessation in growth of chest girth occurs earlier in girls than in boys. Girls show development in breathing capacity inferior to that of boys. Individual growth curves in stature of brothers and sisters are strikingly similar. Not only is the growth in boys quite different from that of girls, but their development is also decidedly more highly correlated. All correlation coefficients for the relationships between the various measurements are positive, and tend to be highest during early adolescence and lowest at 17 years of age. Variation is greater in boys than in girls. The weight-height indices increase between the ages of 6 and 18 years on an average 100 percent. Girls gain between 7 and 12 years of age a greater percentage of their final growth than do boys.

Among the conclusions in the chapters on the anatomical and physiological ages of children, it is stated that boys or girls of the same chronological age may differ in physiological age from one to five years and still be normal in physical development.

The historical review of the literature on growth forms a good survey on this subject. In a large series of tables data on height and weight during growth are summarized for different nationalities, according to all available authors.

A. H. SCHULTZ.

LE DÉVELOPPEMENT PHYSIQUE DE L'ÉCOLIER CUBAIN: BLANC, NÈGRE ET MULÂTRE. ÉTUDE D'ANTHROPOMÉTRIE PÉDAGOGIQUE. By Rouma (Georges)—8°, Bruxelles, 1921, 154 pp. detailed tables.

On the basis of his extended studies of the Cuban children, white, mulatto and black, the author has reached the following main conclusions:

Previous to school age the negro and the mulatto children grow more rapidly in stature than whites. At the time of their entrance into schools the three are nearly equal. Puberty manifests itself sooner in the black than in the white children. Between the ages of  $8\frac{1}{2}$  and 14 years (limit of observations) among the white and black children, and  $10\frac{1}{2}$  among the mulattos, the stature of the girls surpasses that of the boys.

The weight of the body is the same for the three groups at six years of age; later on it becomes slightly superior in the whites.

The proportions of the body in the white children differ from those of the negro; the latter have longer legs and arms and shorter bust. The negro child also shows a lesser development of the thorax cage. The mulatto children occupy an intermediary position. The racial differ-



ences in this respect are maintained in the main throughout the period of growth.

The sitting height of the white child is larger at all ages (6-14) than that of the negro, so that white children require somewhat lower seats or higher desks in school than black children of the same height.

The arm spread is inferior to stature in white children between 6 and 9, and equal to or a little superior to stature between 10 and 14 years of age; among colored children it is at all ages superior to stature.

The cephalic index diminishes gradually from 6-14 years of age due to a slight excess of growth of the skull in the antero-posterior direction.

The chest diameters, relatively to stature, are greater in the white child than in either the negro or the mulatto; and the thoracic index is higher in the white than in the black showing that the chest in the former is deeper. The thoracic capacity is superior at all ages in the white children to that of the colored.

The muscular system and muscular strength is more developed in the negro child than in the white up to at least the age of puberty.

The proportion of right-handed is the same—77% for each of the three groups of children; the proportion of right-handed augments among the whites after school age, but remains the same between 6 and 14 years in the colored children.

The axillary temperature is higher in the colored than in the white child; the pulse rate is however the same in the three groups. The blood of the negro children is richer in the red cells, the white cells and in hemoglobin than that of either the white or mulatto children, and that especially between 6 to 10 years of age.

The mulatto children, in all of their features show the intermediary position, and not a tendency towards a double grouping, one nearer the whites and one nearer the negroes.

#### VARIATION: RACIAL

THE COLOR INDEX OF THE BRITISH ISLES. By Parsons (F. G.)—*J. Anthrop. Inst.*, 1920, L, 159-182.

A good and helpful essay on the pigmentation of the hair and eyes in Great Britain, based partly on Beddoe's and Fleure's and partly on the author's data. Particular attention is given to the "index of nigrescence" which, as modified by Parsons, "is obtained by adding the percentage of the dark brown and black hair to that of the dark eyes and dividing the result by two."

The paper, which regrettably lacks a summary, is replete with interesting data. The pigmentation is seen to differ considerably in different parts of Great Britain, being in general lightest in Scotland and the northern counties of England, darkest in Wales. The women throughout are darker than men; the people in towns are generally darker than those in the surrounding country. Red hair is least frequent in England, most frequent in Scotland; and it appears to be more frequent in the higher than in the lower classes.

Unfortunately the many thousands of records used in the article, while fairly agreeing among themselves and while undoubtedly expressing correctly the general condition in the British Isles, have not been taken with such scientific precision that they could be analyzed more in detail and fully used in other countries. This however is largely a fault of anthropometry which has not yet reached a generally satisfactory and binding definition of methods and classification of colors.

ON THE LONG BARROW RACE AND ITS RELATIONSHIP TO THE MODERN INHABITANTS OF LONDON. By Parsons (F. G.)—*J. Anthropol. Inst.* 1921, LI, 55-81.

An elaborate study of English crania, in which the author combats Pearson's and Macdonnell's idea that the skulls of modern Londoners represent those of the "long barrows" rather than the Anglo-Saxon. He expresses a strong belief—too strong, or at least too sweeping in the opinion of the reviewer—that the shape of the skull "once established, is very permanent, and that most of its characteristics remain for thousands of years" even after the race bearing them has changed its habitat. It all depends.

THE CEPHALIC INDEX OF THE BRITISH ISLES. By Parsons (F.G.)—*Man*, Feb. 1922, 19-23.

Dr. Parsons, one of the most energetic workers now in English anthropology, publishes here a large list of English records on the cephalic index in the British Isles. The records are from many sources and include those of adult males only; also, rather unfortunately, "since some of the measurements were made on living heads and some on dry skulls, the cranial indices of the latter have been converted into cephalic indices by the addition of 8 mm. to the length and breadth, to allow for the absent soft parts." Notwithstanding which the list is of much interest and value.

The cephalic index in the British Isles is slowly rising, the head becoming broader. This is especially noticeable in the highly educated where the head as a whole is also larger. The average cephalic index of the British soldier of the eighteenth century was 76.4, that of the soldier of the late war 78. The average Londoner of the seventeenth century was 76,—the present patients of St. Thomas' Hospital, London, are 77.7. The cause of these changes has not yet been definitely determined, the author is inclined to suspect mixture, though it would hardly seem that admixture could be responsible for such general manifestation.

As to head size among the well educated, if we "add the lengths to the breadths of the heads of the presumably more intellectual groups, such as University and King's College staffs, the British Association, British anatomists and educated Englishmen and Scotchmen, we find that they always give an average sum reaching or exceeding 350, the educated Scots heading the list with 357.5, while in the records it is

quite exceptional to find the 350 limit reached." (Compare Talko-Hryniewicz, on Poles; also Constantin, on the French.) The corresponding average in 3000 male criminals is only 342.

The records however "do not give us any reason for thinking that the size of the modern Englishman's head is increasing with its increasing rotundity; in fact, both the Saxons and Long Barrow folk, from the fusion of whom most of our blood is derived, seem to have had rather larger heads than the average modern Englishman, and there is no reason to believe that they were larger men physically."

CONTRIBUTION À L'ÉTUDE DES CELTES. By Piroutet (Maurice)—*L'Anthrop.*, 1919, XXIX, Nos. 3-4, 213-249.

In the first instalment of this promising work on the Kelts, the author deals with, 1) The first relations of the Greeks with the Kelts, and to what peoples was the name of "Kelts" applied; 2) The people of the old cemeteries of La Marne. His further contributions to the subject and his conclusions will be awaited with interest.

CONTRIBUTION À L'ÉTUDE DES CORRÉLATIONS PHYSIQUES ET PSYCHOSOCIOLOGIQUES DE LA CIRCONFÉRENCE CEPHALIQUE. By Constantin (André)—*L'Anthrop.*, 1919, XXIX, Nos. 3-4, 265-288.

Interesting series of observations on French soldiers and their officers showing that the size of the head as obtained by the circumference bears on the average a direct relation to grade and development of intelligence. Compare Parsons, Talko-Hryniewicz].

Collateral results of interest show that, a) The circumference of the head augments more regularly with the mass and vigor of the body than with its height; b) whatever the form of the head, it is always those who have the highest stature that have on the average also the largest head; c) men born in cities of at least 50,000 inhabitants showed a notably smaller head circumference than the general mean of the men of same stature that were examined; d) individuals of mixed type, everything else being equal, tend to show a larger head than either the blonds or brunets.

(THE FACIAL ANGLE OF BOHEMIAN AND MORAVIAN SKULLS.) By Neuwirth (Fr.)—*Národop. Věstník Č.S.*, 1921, XIV, No. 2, 65-68. (In Czech.)

Under the auspices of the Anthropological Institute of the Czech University of Prague (Dir. Prof. J. Matiegka), the author took facial measurements on 372 well preserved crania proceeding from 6 Bohemian and 3 Moravian ossuaries.

The Frankfurt-Agreement angle (angle formed by the nasion-alveolar point line and the Frankfurt horizontal line, *i.e.*, the line between the lower point on the lower border of the orbit and the higher point externally of the auditory meatus), gave the average of 87.3 for the males, 87.7 for the females, coeff. of var. 3.72%. These data compare closely



with those on the Swiss (Bündner)—87.3; Tyrol—88.-; and Bavaria—88.3-88.9.

The nasion-alveolar point—alveolar pt.—basion angle (Rivet, Hrdlička), averaged 73.9 for the males and 74.4 for the females; coeff. of var. 5.25. It agrees closely with the index in Slavs in general (72.2-74.4), and is slightly superior (face more orthognathic) than in northern and western Europe (70.4-72.6).

The Czech and the Moravian series were practically identical.

(THE MAIN ANTHROPOLOGICAL CHARACTERISTICS OF THE COMMON PEOPLE AND OF THE CULTURED CLASSES IN POLAND. In Polish with abstract in French.) By Talko-Hryncewicz (J.)—*Bull. Polish Ac. Sc.*, Krakow, 1919, LIX, 543-553.

In all parts of Poland, notwithstanding the sameness of race, there are appreciable physical differences between the common people and the rather numerous Polish nobility. The latter presents on the whole a better type, differing from that of the peasant by higher stature, somewhat greater pigmentation, and larger (both absolutely and relatively) as well as more rounded skull. More recently the author studied a large series of persons of higher education regardless of class derivation (one half at least proceeding from the common people). The results show that men of this class are also distinguished from the uneducated, or but poorly educated, by a higher stature and by a larger head (even in same statures), but the form of the head, moderate brachycephaly, is about the same. [Compare Constantin, Parsons.]

(THE UPPER LIMBS AND THE CONDITION OF THEIR PARTS IN VARIOUS PEOPLES. In Polish, with abstract in French.) By Talko-Hryncewicz (J.)—*Bull. Polish. Ac. Sc.*, Krakow, 1920, LX, 29-53.

The study extends to a large series of soldiers of various ethnic groups of old Russia, and to German and Austrian war prisoners. All the groups studied have arms relatively rather long. Their mean length (to acromion) varies from 46.4 to 49.3 percent of stature. The longest arms are possessed by the Kirghiz (49.3), then Buriats (48.-); the shortest by the Finns (47.-), Jews (46.9), Georgians (46.8), Armenians and Tatars (46.5) and Greeks (46.4). The Slavs are intermediate.

The Kirghiz and Buriats have relatively the longest forearm (*Ind. brach.* 79.-77.8), the Tatars, Letts and Czechs the shortest (*I.b.* 73.8, 73.4, 72.7).

The relative proportions of the upper limbs to stature do not change with decrease or increase in the latter.

The hand index is greatest among the Kirghiz and Finns (48.7, 48.5); smallest among the Georgians, Buriats and Greeks (44.8, 44.6, 44.4).

The numerous records, made by an observer well known for his careful work, are a distinct contribution to anthropology.

ON THE EURYGNATHISM OF SOME CRANIA FROM MINHO. By da Costa Ferreira (A. Aurelio).—*Bol. Geog. Soc. Lisboa*, 1920, No. 12, 8 pp.

The author calls attention to the plurality of types of eurygnathism. The differences between the internal bi-orbitary diameter and the bimalar diameter show that in Portugal the province of Minho is the one in which the population is most eurygnathic; but, taking the individual degree of eurygnathism and the cephalic index, it is seen that it is not to the brachycephalous element alone that we must attribute exclusively the high degree of eurygnathism. There are two different dolichoid types. The author rightly points out the necessity of revising the study of eurygnathism.

CRÁNEOS DE VIZCAYA. By Aranzadi (T.).—*C. R. Ass. Esp. Prog. Cienc.*, Congr. Bilbao, 1920, VI, 63-88, 6 pl.

A study of 29 adult Basque crania. The skulls range from dolicho- to brachycephalic (*C.I.* 71.9-82.-; means, m. 76.3, f. 77.8), low (B-Bg average, m. 13.1, f. 12.2 cm.), of moderate dimensions (C. Mod., m. 15.3, f. 14.6). A united series of 75 male and 61 female crania gives the mean *C.I.* for males of 76.5, for females 77.4; B-Bg. height, m. 13.1, f. 12.5; C. Mod., male, 15.34. female 14.69. The face is rather small, leptoprosopic (D. biz., m. 13.1, f. 12.2; Nas-Alv. pt. height, m. 7.-, f. 6.6; *F.I.* m. 54.9, f. 54.9); the nose is lepto- to mesorhinic; orbits mesoseme.

The remarkable lowness of the Basque crania, as well as their other features, have not it seems received as yet due attention, though known since Broca and Topinard. The reviewer would further suggest that not enough attention has yet been given to the possible relationship of the Basque cranial type with the remarkable low Bremen and Zuyder Zee crania (Virchow, Gildemeister), the lowness of which has not quite convincingly been suggested as due to artificial deformation.

TRIANGULACIÓN DE LA CALVARIA EN CRÁNEOS DE VIZCAYA. By Aranzadi T. de).—*Bol. R. Soc. Esp. Hist. Nat.*, Madrid, 1921, XXI, 234-249.

A study of various angles 29 Basque crania (angles formed by such lines as the basion-bregma glabella-lambda, etc.). The results are of interest but are masked in a maze of figures, and there is no summary. Publications of this nature, however pleasing they may be to the author, are trying on his readers.

THE HYBRID ORIGIN OF THE MEDITERRANEANS. By Giuffrida-Ruggeri (V.).—*Man*, Dec. 1921, XXI, No. 12, 180-182.

The author, acknowledging the presence of some negro admixture in the Mediterranean populations, believes the bulk of the Mediterraneans to be mixed-white origin. He is not as clear as would be desirable in this respect, but draws in, unwarrantably it would seem, important racial increments from the "drying up of West Central Asia in the neolithic period." The fallacy of central-Asiatic origins is extending its work.

THE ANTHROPOLOGY OF CYPRUS. By Dudley Buxton (L.H.)—*J. Anthropol. Inst.*, 1920, L, No. 1, 183-235.

A good piece of work, though suffering slightly from excess of mathematics and a lack of a succinct summary.

The report deals with both crania and the living. There is considerable evidence in the eastern parts of the Mediterranean basin of the presence of both dolicho- and brachycephaly. The two types are well represented in Lycia and also, the writer finds in Cyprus. In Crete the more oblong type predominates. As far as now possible to determine, the population of Cyprus does not appear to have changed appreciably in its main physical characteristics since the Bronze age.

The paper is nicely supplemented with geographical, historical, demographical (counts of population since 1570) and cultural data, and there are added numerous tables of detailed measurements.

APPUNTI DI ETNOLOGIA EGIZIANA. By Giuffrida-Ruggeri (V.)—*Aegyptus*, Milano, 1921, II, No. 2, 179-189.

This article deals with two subjects of interest to physical anthropology. The first is the Asiatic origin of the Hippocratic "macrocephaly" and the illustrations of it in Egypt. The most ancient picture of such a deformation is found in the Kheta, prisoners of Ramses III. As to the head-portraits of the family of Amenophis IV the author believes that we have here only an excessive stylization by the artist an artifice in hairdressing.

The second subject is that of the Egyptian pictures of the Libyans before the XIX Dynasty. The author discusses possible indications that the most ancient Libyans were of light color, as painted in the XIX Dynasty, and concludes that such assertion is not documented enough. His hypothesis is that it was an intrusion of blond Nordics which influenced the artists of the XIX Dynasty who pictured the Tamahu defeated by Seti I.

V. G.—R.

BABYLONIA & ASSYRIA. By Meissner (Bruno), *Kulturgesch. Bibl.*, 1920, III, Heidelbg., Review by Langdon, *Man*, June 21, 93.

The civilization of ancient Mesopotamia begins with the Sumerians in the neolithic age before 5000 B. C. Their dynastic lists have been fixed with certainty to 4500, back of which lay two long semi-historical dynasties. Writing begins to appear soon after 4000 and from that period onwards the volume of business records which concern every aspect of economic life of the Sumerians and Semites is inexhaustible.

3400 B. C.—Bust of a king of II Sumerian Dynasty has long plaited beard, with shaven cheeks and lips.

The physical types of the Sumerian and Semite are defined, but the author, according to Dr. Langdon, fell into grievous error when he described the Sumerian as brachycephalous or round-headed; measurements of the numerous heads of statues and statuettes show that the



Sumerians were decidedly dolichocephalous. Since they are represented with cleanly shaven heads, the problem is not difficult; and even a good photograph of a head convinces the anthropologist.

The long history of Sumer and Accad, Babylonia and Assyria, down to the Persian period occupies the second chapter. It is necessarily only an arid survey of dynasties with requisite diversions concerning racial movements.

ANTHROPOLOGICAL RESEARCH IN INDIA. By Sarat Chandra Roy—*Man in India*, 1921, I. No. 1, 11-56.

Refers in a somewhat general way to what has been done in all branches of anthropology in India, adding valuable bibliographic references.

THE FIRST OUTLINES OF A SYSTEMATIC ANTHROPOLOGY OF ASIA. By Giuffrida-Ruggeri (V.)—Transl. from Ital. by H. Chakladar, 8°, *Calcutta Univ. Press*, 1921, 110 pp.

The well-known author, whose premature loss is much to be regretted, assumes that "there have been three genetic centres of the races in Asia—one for the Eurasiatic North (formation of the Leucoderms), another for eastern Asia whence the formation of the yellow stock and its derivatives in America and in Oceania, and a third for the southern regions. The two northern centres may have been contiguous if we placed them, for instance, towards Zungaria. "If we place a single filum of ancestral representatives in central Asia, and admit that the passage of the southern barrier was effected in successive waves, then it follows that the third genetic centre placed by us in the southern regions, may be connected originally with central Asia."

Unfortunately these hypotheses, and particularly that relating to the south-Asiatic and oceanic negrito, lack on one hand satisfactory evidential foundation, while on the other there are indications pointing in other directions. Anthropometry alone, which is the mainstay of the author, is not capable of deciding these questions.

(CONTRIBUTIONS TO THE CRANIOLOGY OF NORTH-EASTERN ASIA. In Polish, with abstract in French) SKULLS OF KAMCHADALS, KORJAKS AND ALEUTS. By Talko-Hryncewicz (J.)—*Bull. Polish Ac. Sc.*, Krakow, 1919, LIX, 187-221, 1 pl.

The rare material is restricted to 8 skulls (1 Korjak, 6 Kamchadal, 1 Aleut), and only 4 of these are in good condition. The *C.I.* of four of the specimens (3 Kam., 1 Korj.) ranges from 76.4 to 79.2, while that of the Aleut (fem.) is 80.9; the *H.L.* index of the five reach from 71.9 to 79.5 in the Kam., 75.3 in the Korj. 73.8 in the Aleut. The *Nasal Index* in the Kam. is 43.3-50, in the Korj. 47.2, in the Aleut 39.2. The face in the Kam. is rather low—*F.I.* (upper) 45.3-48.8, in Korj. 53.7, in Aleut 55.—. The Korjak and Aleut skulls, themselves related, differ perceptibly from those of the Kamchadals which are plainly mongoloid.

THROUGH CENTRAL BORNEO. By Lumholtz (Carl)—8°, 2 vol., N.Y., 1920 (Scribner's Sons).

An account of two years' travel among the Dyak tribes of inland Borneo by the well-known veteran freebooter-explorer of Australia, northern Mexico and other wild regions.

The two handsome volumes are replete with interesting and reliable information of ethnological nature. For Physical Anthropology there are, outside of a few casual notes, only the portraits, many of which are however, very good, in full face or full profile. It is a pity that these trips could not have been associated with a physical study of the tribes, and with at least a preliminary inquiry as to old caves and their contents which hold such promise in that part of the world.

THE STATUS OF PHYSICAL ANTHROPOLOGY IN POLYNESIA. By Sullivan (L.R.)—*Proc. I Pan-Pacif. Sc. Conf.*, 1921, I, 63-69.

A general presentation of the status of anthropological (somatological) knowledge of the Polynesians, with a bibliography. Pleads rightly for a systematic and intensive work by well trained specialists.

A CONTRIBUTION TO SAMOAN SOMATOLOGY. By Sullivan (L.R.)—*Mem. Bern. Pauahi Bishop Mus.*, Hawaii, 1921, VIII, No. 2, 81-98, 6 pl.

The report is based on the study, by Messrs. E. W. Gifford and W. C. McKern, of 70 male and 23 female, living Samoans. Principal dimensions: Stature, m. 171.7, f. 161.2; C.I., m. 81.3, f. 80.8; F.I. (anat.) m. 89.9, f. 89.8; N.I., m. 73.6, f. 76.3. On the basis of the observations the writer is inclined to regard "the Samoans as most closely allied to the Mongoloid race of mankind, and to assume that the differences are probably due either to a slightly different evolution since the time of their separation and isolation from the parental stock, or to the retention in the Samoans of a primitive character which through different evolutionary processes has been lost in most of the Mongoloid types, and thinks it unlikely that the differences are due to racial intermixture. . . . In conclusion we may say at least that it is far more difficult to reconcile European racial origin for the Samoans and Polynesians in general than it is to assume Mongoloid affinities and origins."

To the reviewer many of the portraits indicate admixtures.

THE ANTHROPOLOGY OF THE HAWAIIAN RACE. By Tozzer (Alfred)—*Proc. I Pan-Pacif. Sc. Conf.*, 1921, I, 70-74.

Historical notes on the population of Hawaii, showing that "this paradise at the crossroads of the Pacific has been in every truth a centre of miscegenation perhaps not equalled in the same number of people anywhere else in the world. The study of the racial complexity here opens up a fertile field for the eugenist, the student of heredity, the sociologist, the psychologist and the economist as well as for the anthropologist."

A PROPOSITO DELLA LEPTORRINIA DEI MORIORI E DELLA LORO DEFORMAZIONE CRANICA (1 fig.). By Giuffrida-Ruggeri (V.)—*Rend. R. Ac. Sc.*, Napoli, XXVII; repr. 12 pp.

Interprets, very properly it seems, the leptorhiny of the Moriori on a physiologico-mechanical basis.

A FEW ANDAMANESSE SKULLS WITH COMPARATIVE NOTES ON NEGRITO CRANIOMETRY. By Sullivan (Louis R.)—*Anthrop. Papers, Am. Mus. Nat. Hist.*, XXIII, Pt. IV, 181-201.

Description and measurements of three Andaman Islanders' skulls, with discussion of previously published data on the Semang and Philippine Islands' Negrito crania. Reaches the conclusion that "while the three groups are quite different in some respects, on the whole the differences are not as great as might be expected under the conditions. The data at hand do not seriously contradict the assumption that these three groups are quite closely related racially and the offspring of the same stock." However "The entire Negrito group is worthy of more detailed study. The Andamanese, particularly, on account of their isolation are deserving of more serious study by anthropologists."

The negrito problem is indeed one of the most fundamental problems not merely of southern Asia and the Pacific, but of anthropology in general.

A TALK WITH SOME GABOON PYGMIES. By Migeod (F.W.H.)—*Man*, Feb. 1922, 17-19.

A few measurements and descriptive notes of the Babongo negrillos on the upper Ogowe river, Gaboon. Average stature in men, 4 feet 7½ inches. Head meso- to brachycephalic.

#### VARIATION—THE SKULL

DIE BEDINGUNGEN ZUR BILDUNG VON KNOCHENKÄMMEN AM SCHÄDEL DER PRIMATEN. By Mollison (Th.)—*Sitzber. Heidelb. Ak. Wiss.*, 1919, 3 Abh., 9 pp.

Author deals with the significance of the sagittal and occipital crests and the value of their presence or absence as marks of blood relation of any given species or varieties. A particular consideration is given to different significance of the absence of these crests in the Gibbon and in the Pithecanthropus. The condition in these two forms is not homologous. In the Gibbon the absence of the crests is the result of small development of the temporal and nuchal muscles, while in the Pithecanthropus there are no crests due to the enlarged size of the vault. The presence or absence of these crests is therefore no criterion of a relation or non relation of any two species.

The important sex factor is not given due consideration.

HISTOLOGISCHE UNTERSUCHUNGEN ÜBER NORMALE UND ABNORME SYNOSTOSE DER HIRNSCHÄDELNÄHTE. By Hauschild (M. W.)—*Verh. d. anatom. Ges., Ergzh. Anatom. Anz.*, 1921, LIV, 85-93.

Three conditions are necessary for the closure of a fetal suture: (1) the close apposition of the edges of the bones; (2) sufficient thick-



ness of these edges; (3) formation of blood vessels within the bones at their edges, the development of these vessels being dependent on condition 2. The vascularisation of the suture occurs from the diploë alone and not from periost or dura mater. After birth the three conditions for synostosis still hold, and their partial absence is regarded as responsible for persistence of sutures. The thin, sharp edges of the sutura squamosa, for instance, prevent the closure of this suture for a very long time. Also the insufficient thickness of bone in many female skulls causes a retardation in synostosis. Scaphocephalic skulls show a heavy layer of osseous tissue on the tabula interna beneath the obliterated sagittal suture, which is deposited by the dura mater.

A. H. SCHULTZ.

A NOTE ON THE POST-CORONAL SULCUS WITH DISSECTIONS OF THE EPICRANIAL APONEUROSIS IN TWO CASES OF ITS OCCURRENCE. By Blair (Duncan M.)—*J. Anat.*, Oct. 1921, LVI, pt. 1, 44-47.

The author found this depression, more or less marked, in 238 of 710 west Scottish skulls (33.5 per cent). It was about equally frequent in the two sexes, but occurred much more frequently in metopic than in ordinary skulls.

Dissections of two subjects, made with the view of determining if possible the cause of this depression, have led the author to the following conclusions:

"Were the post-coronal sulcus due to an intra-cranial cause, it would be reasonable to expect an exaggerated reversal within of the groove on the outside, but in both the specimens dissected, the smooth, transverse depression appears to be purely a feature of the outer table of the skull, and it is therefore suggested that its presence may be caused by the persistence of the unusually strong transverse band of the epicranial aponeurosis which, in both these cases, was found to be within it.

"It is interesting to note the prevalence of this post-coronal sulcus in skulls of the West Scottish type as exemplified in the Glasgow University Collection. The greater incidence among metopic skulls is also a striking feature. As already pointed out, the depression occurs in the majority of such skulls and more than twice as frequently as in the non-metopic variety."

SOBRE A FORMACAO DA PAREDE EXTERNA DA ÓRBITA. By da Costa Ferreira (A.A.)—*Arquiv. Anat. & Antrop.*, 1919, V, 288-299, 5 pl.

Author describes a small series of defects in the postero-external wall of the orbits, in a young chimpanzee and in human infants.

DAS VERHÄLTNIS DES GOLDENEN SCHNITTES IM BAU MENSCHLICHER SCHÄDEL. By Cohn (L.)—*Verh. anatom. Ges., Ergzh. Anatom. Anz.*, 1921, LIV, 175-180.

The author measured the distances, nasion—prosthion, nasion—bregma, and nasion—lambda, on a modest number of skulls of different races. He finds in all cases that the proportion between the first and second measurement is very nearly equal to the proportion between the second and third measurement according to the formula  $A : B = B : C$ .

He considers this a general law for all human skulls. The paper is largely a juggling of figures and is of very little morphological value.

A. H. SCHULTZ.

UEBER DIE MEHRFACHE ANLAGE DES MENSCHLICHEN ZWISCHENKIEFERS. By Peter (K.)—*Verh. anatom. Ges., Ergzh. Anatom. Anz.*, 1921, LIV, 100-104.

A short report on new investigations on the development of the intermaxillary bone in man. This was found to originate in three parts: the alveolar arc with the facial portion, the palatine portion, and the nasal portion. It is not certain if this developmental process can be found in all embryos, since the variability, especially of the anterior region of the growing palate, is very great. The sutura intrancisiva is not a true suture, but a groove caused by the ductus naso-palatinus and vessels and nerves.

A. H. SCHULTZ.

UEBER DIE BEANSPRUCHUNG UND DEN AUFBAU DES MENSCHLICHEN UNTERKIEFERS UND DIE MECHANISCHE BEDEUTUNG DES KINNS. By Grunewald (J.)—*Arch. f. Anthropol.*, 1920, XVIII, 100-113.

The human mylo-hyoid and internal pterygoid muscles have a flexion effect on the mandible which exerts the greatest stress at the symphysis. The latter region has, therefore, to be strengthened, which is accomplished chiefly by the formation of the chin. The partial or complete absence of the chin in primitive races is explained as a lesser functional adaptation. The effect of the mastication musculature on the corpus and ramus of the mandible, as well as the general architecture of the latter bone, are discussed in detail.

A. H. SCHULTZ.

DAS INNERE RELIEF DES UNTERKIEFERASTES. By v. Lenhossék (M.)—*Arch. f. Anthropol.*, 1920, XVIII, 49-59.

The relief of the inner side of the human ramus mandibulae is described in detail and the variability of its different parts discussed. The insertions of muscles exert a very evident influence on this relief. In the two African anthropoids, chimpanzee and gorilla, the relief of the inner side of the ramus is very much the same. In the orang, on the other hand, the corresponding features are quite different; they are also somewhat different in the two sexes. A study of the inner side of the mandible of Piltdown leads the author to the emphatic conclusion that the latter is not human but the jaw of an anthropoid ape very closely related to chimpanzee. The Piltdown jaw has no linea mylohyoidea, its recessus mandibulae is strikingly broad and concave, and its sulcus mylohyoideus lies considerably behind the foramen mandibulare and therefore does not meet the latter foramen, as in all human mandibles. The Heidelberg jaw shows typical human conditions in the relief of its inner side, which are far removed from those found in apes. The paper closes with a discussion of the relation of the trabecular system of the mandible to the different structures of the relief on the inner side of the ramus.

A. H. SCHULTZ.

## NOTES

A joint English-American expedition, organized by Joseph Bancroft of Cambridge University, England, left in November for Peru with the purpose of studying the physiological effects on, and the adaptation of man, to life at very high altitudes varying from 14,000 to 16,000 feet. The principal work of the expedition, which amongst others carried with it three medical men from Harvard University, will be among the mining population at Cerro de Pasco, after which the expedition will visit Tieleo. Investigations will be directed principally to the circulatory and respiratory systems, and should prove of considerable interest to anthropology.

*The Bayard-Dominick Marquesan Expedition.* The Bayard Dominick Marquesan Expedition for anthropological research has recently returned after fifteen months in Eastern Central Polynesia. . . . For the physical survey which rounded out the anthropological investigations as they had originally been planned, a series of two hundred measurements of full-blooded and mixed Marquesans was obtained, accompanied by observations, hair samples and photographs of every individual. Mr. Louis R. Sullivan, of the American Museum of Natural History, is in charge of the compilation and publication of these anthropometric and somatological data. An early presentation of the results of these researches is planned by the Bishop Museum.

*Science*, December 9, 1921, 571.

*Palaeontologia Sinica.* The Geological Survey of China has undertaken the preparation and publication of a series of monographs on the remains of the animals and plants which inhabited China from the remotest past of its geological history to the period which preceded the one in which we live to-day.

The work will be issued under the general title of "Palaeontologia Sinica." It is divided into four series. Series II will deal with Prehistoric Man in China, and the following articles are announced so far:

Vol. I, Fasc. 1.—The Neolithic Cave-deposit at Sha-Kuo-T'un in Fengtien (in preparation).

1. Topographic Notes and Description of Artifacts. By J. G. Andersson.

2. Human Skeletal Remains. By Davidson Black.



The general work of editing is undertaken by Professor J. G. Andersson, Mining Adviser to the Chinese Government, V. K. Ting, the Director of the Geological Survey and Dr. H. W. Wong.

*New Anthropological Journal.* The *American Journal of Physical Anthropology* has received the first three numbers of *Man in India*, a "quarterly record of anthropological science with especial reference to India," published and edited by Sarat Chandra Roy, Ranchi, India. The journal appears in a small octavo form, and will serve all branches of anthropology. Subscription price outside of India £1.

*New Periodical.* An announcement bears the news of the establishment of a new anthropological journal in Poland. The journal will be known as the "Archiwum Nauk Antropologicznych" (Archive of the Anthropological Sciences), is to be published under the auspices of the Warsaw Scientific Association, will be edited by Professor K. Stolyhwo and will appear at such intervals as conditions will make advisable. Its address will be: Instytut Nauk Antropologicznych, Ul. Śniadeckich, 8, Warsaw, Poland. Přejeme zdaru.

The first *Russian Eugenics Society* was founded in Petrograd and Moscow in 1919.

A *Eugenics Bureau* was established in 1921 under the auspices of the Russian Academy of Sciences at Petrograd, by Dr. Jun Philiptschenko, Professor of Experimental Zoology and Genetics at the Petrograd University.

*Eugenics in India.* The "Indian Eugenics Society" was organized at Lahore on Monday, June 20, 1921. The Secretary reports over 150 members with branches at Lahore and Simla. . . . The aims of the Society are listed as follows: (1) To urge the importance of a critical study of problems relating to race improvement from Indian point of view and having regard to Indian traditions and present conditions. (2) To spread a knowledge of sex and heredity so far as that may affect the improvement of the race. (3) To modify and direct matters relating to human parenthood according to eugenical ideals. (4) To further Eugenic teaching at home, in the school and elsewhere.

An International Congress of Maternal and Child Welfare will be held in Paris, July 6 to 8, 1922.

On October 5, 6 and 7, Professor Arthur Keith, of London, delivered at the Johns Hopkins Hospital, Baltimore, the 13th course of the Herter Foundation lectures, on the theme "The Differentiation of Modern Races of Mankind in the Light of the Hormone Theory."

Dr. William K. Gregory delivered on March 4, 11, 18 and 25 at the Wagner Free Institute of Science in Philadelphia, four lectures on "Evolution of the Human Face."

A course of ten weekly lectures in Applied Anthropology has been given under the auspices of the Young Men's Christian Association and the Institute of Vocational Research of Washington, D. C., by Dr. Aleš Hrdlička. The course was adapted to the needs of persons employed in work which requires a sound knowledge of human nature and human characteristics. It applied directly to the work of Teachers, Vocational Counsellors and Personnel Managers. It involved the following lectures: (1) The Evolution of Man. (2) Man's Spread over the Earth. (3)-(5) The Origin and Racial Composition of the Principal European Nations. (6) The American People (The Old Americans, Immigration and Expected Results). (7)-(8) Human Variation. (9)-(10) Human Heredity and Eugenics.

At the invitation of the Presbyterian Ministers' Association, Dr. A. Hrdlička addressed, on February 27, at the New York Avenue Presbyterian Church, a large meeting of Presbyterian ministers of Washington on the subject of "The Origin of Man in the Light of Most Recent Investigation."

In commemoration of the fiftieth anniversary of the appearance of Darwin's "Descent of Man," "Naturwissenschaft" of February 25, 1921 (Vol. IX, H. 8) is devoted to the subject of Man's Evolution. It contains articles by G. Steinmann on the "Derivation of the Human Species"; the "Descent of Man" by Th. Mollison; "Man as a Primitive Animal" by M. Voit; and the "Origin of the Intellect" by K. Buhler. (See Abstracts.)

Professor Arthur Keith F.R.S., Curator of the Museum of the Royal College of Surgeons, London, and Past President of the Royal Anthropological Institute, has been knighted by the King of England. This *Journal* joins in congratulations.

Dr. A. A. Mendes-Corrêa has been appointed Ordinary Professor by the Faculty of Sciences of Oporto.

Miss Julia C. Lathrop, for nine years the able head of the Children's Bureau, U. S. Department of Labor, has resigned. Her place is taken by Miss Grace Abbott.

Professor Wilhelm Waldeyer bequeathed his brain, skull and the skeletal parts of his hands, to the Berlin Anatomical Museum.

\* Émile Houzé, Professor of Anthropology at the University of Brussels and at the École d'Anthropologie of that city, died at Brussels on April 15, 1921.

\* Dr. Peter Thompson, Professor of Anatomy in the University of Birmingham, died in the forty-ninth year of his age on November 16, 1921.

\* We learn with deep regret of the death of the eminent French Archeologist and Anthropologist, Professor Émile Cartailhac. He died in advanced age, of apoplexy, on November 25, 1921, at Geneva.

\* On November 21, 1921, Italy lost its foremost active Anthropologist, Dr. V. Giuffrida-Ruggeri, Director of the Anthropological Laboratory and Professor of Anthropology at the University of Naples. He died after a brief illness in the 50th year of his age. The premature loss will be universally regretted.

The following corrections should be made in the paper "A study of the supra-condyloid process in the living," R. J. Terry; vol. IV, No. 2, of this JOURNAL:  
P. 133, table II, change 20 to 21; p. 137, line 26, 520 to 515; 243 to 248; line 27, 6 to 7; line 28, 1.15 to 1.16; line 29, 243 to 248; line 34, "arm" to "adult arms"; line 36, 1040 to 1030; p. 139, line 18, 520 to 515.



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## PHYSICAL ANTHROPOLOGY OF THE OLD AMERICANS

PIGMENTATION; GREY HAIR; LOSS OF HAIR

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### I. PIGMENTATION

#### INTRODUCTORY REMARKS

By anthropology of the Old Americans is meant the status, physically, physiologically and demographically, of the oldest parts of the white

population of the United States, as contrasted with the American population at large and with other units of the white race.

Since discovery this country has been an ever-increasing eddy that drew in and still draws the offshoots and surplus of a wide range of white man's populations in the older parts of the world, and a large majority of these newcomers have remained, made this their permanent home, and intermingling with others have been gradually building up the great new nation.

The changed environment, the many new stimuli, the freer and more virile as well as strenuous life, the on the whole better and more abundant nourishment, the more wholesome conditions in general, and besides all the steadily growing admixture of blood, have now been acting on the older parts of this nation for from one to over three centuries. What are the results? Here is a vast natural laboratory the subject of whose multitudinous experiments has been man himself—how has he responded, and what are the indications for the future? Satisfactory answers to this can only be reached through intensive scientific investigation.

We observe on all sides in the American, individually and collectively, a mental freshness and vigor not equalled it seems in any other country; but these matters are difficult of proper gauging. They elude measurement or strict appraisal. But there are the physique and the physiological functions of the American stock, all of which yield more or less readily to exact determinations, the results of which would be of the utmost value. The need of such determinations has long been felt, and it was only the chronic lack of means for scientific purposes that has thus far prevented the carrying out of the desirable research in this direction. Notwithstanding this difficulty a considerable amount of work has already been accomplished. This particularly on the American child, on the students of our colleges, on the drafted men and soldiers during the Civil as well as the late wars,<sup>1</sup> and on some of the immigrants.

Nevertheless these studies, though highly useful, are still more or less incomplete and insufficient, and the records on the recruits and soldiers both from the Civil and from the recent wars suffer from the additional

<sup>1</sup> See writer's "Physical Anthropology," 8<sup>o</sup>, Wistar Institute, Phila., 1919; *The Amer. J. Phys. Anthropol.*, 1918-'21; the publications of the Children's Bureau of the Surgeon General U.S.A. and of the U. S. Bureau of Education.

Demography of United States is being taken care of by the U. S. Census and by the principal life insurance companies.

defect of not having been secured by well trained observers and with the appropriate instruments. In none of these researches furthermore, was there a sufficient selection of the subjects as to American ancestry. They deal with the child, student or recruit in America rather than American. Their results are not capable of giving satisfactory answers to the questions concerning the changes already effected or being effected in that part of the population which has longest been subject to the American environment; and they give us little or nothing on the general adult population.

In order to supply as far as possible the need in these directions the writer undertook, in 1912, a systematic anthropological study of the oldest part of the "Old Americans." By "Old Americans" he designated all those who in their families had no mixture with more recent elements on either side for at least three generations. The study lasted until the present year. It was carried on in the anthropological laboratory of the U. S. National Museum, but eventually also in the field, and the utmost care was exercised throughout to assure the reliability of the data secured.

The examinations comprised the most important of measurements on the body with a series of physiological tests and visual observations. They were restricted to healthy adults of both sexes, of between 24 and 60 years of age, and without any selection as to class or territorial derivation. The subjects were all volunteers and included members of some of the foremost American families.

The study proved throughout one of the most absorbing interest; but an unexpected difficulty developed in finding sufficient numbers of persons of the right qualifications. Native Americans of two generations on each side born in this country may already be counted by the millions, but those of three generations or more are far scarcer, except in certain limited inbred regions or communities. It was on this account that short trips had eventually to be taken into Massachusetts, Connecticut, Virginia, and finally the mountain region of Tennessee, where highly interesting additional series of subjects were examined.<sup>2</sup>

The final number of subjects on whom observations were made counts nearly two thousand. The large majority of these were from the eastern States, the States that furnished the old stock to the rest of the

<sup>2</sup> In Virginia a very efficient help with the work was given by Professor Robert Bennett Bean, of the University of Virginia. After mastering the methods employed by the writer and with the same instruments, he measured a good series of the U. S. Engineers located at that time near the University.



country. In the east all the States are represented in the series from Maine to the Gulf, and a good comparison will be possible between the Yankees and the Southerners.

The first preliminary report upon these studies was made before the XIX International Congress of Americanists in 1915, at Washington;<sup>3</sup> the second before the recent International Eugenics Congress in New York; and a third, in April of this year, before the National Academy of Sciences, in Washington. The final data on measurements and the more technical observations are now in preparation. The data on pigmentation which are of wider public interest and the most readily understood, have also been prepared for the present Report of the Smithsonian Institution under whose auspices the whole investigation was conducted.

## II. DEFINITIONS

By pigmentation we mean the amount and nature of coloring matter in the skin, eyes and hair; though the condition is also manifest in the mucous membranes, in the sclerotic, and even in other parts and tissues of the body.

The pigmentation of an individual is not the same throughout his life, and will not appear the same under all conditions. It is much influenced by age, prolonged exposure or confinement (skin, hair), and state of health. In addition the appearance of the skin, eyes and even hair will be modified by the blood (flush, paleness or blueness of skin, brightness or dullness of eye, dull dryness of hair), the state of feeling, the presence or absence of the natural sebaceous or oily coating (skin, hair), and the presence of minute air bubbles between the cells of the hair occasionally after great nervous strain, or normally in advancing years (greyness).

The coloring substance or substances, the exact nature and differences of which are still a matter of some uncertainty, occurs in the shape of minute granules which in the skin are lodged in the deeper layers of the epidermis, in the eye infiltrate various cells of the iris, and in the hair are disseminated through most of the cells of the hair shaft. The pigment, generically known as melanin, is much alike in various organs of the same individual, in different individuals of the same race, and in different races of man; but there are indications that it may represent a complex of related forms differing by slight chemical variations.

The main function of pigmentation is a protection of the skin and the eyes against those rays of the sun which would be harmful to the

<sup>3</sup> Published in the Proceedings of the Congress, Wash. 1917, pp. 582-601.

organism; in addition to which pigment may possibly serve also as an accessory means for the elimination from the system of certain substances that result from the metabolism in the cells. A complete lack of pigmentation, as abnormally present in full human albinos, is accompanied by weakness of the eyes as well as great irritability of the skin.

The acquisition of pigmentation in man is of ancient ancestral origin. According to various indications, early man, up to at least the middle of the Palaeolithic period, was brown in color, with hazel- to dark-brown eyes and reddish-brown to black hair. He was a product of the tropics or semi-tropics and could not have developed there without adequate pigmentation.

Before the middle of the glacial period this early man reached western Europe, which according to many indications became the cradle of his further differentiation. It was primarily from Europe that he spread into other parts of the world, and it was from western Europe that he eventually followed the final recession of the ice northward, until he peopled what are now Denmark, northern Germany and the Scandinavian peninsula.

These regions concern us particularly in this connection. Under the peculiar post-glacial climatic and environmental conditions of north-westernmost Europe, combining in all probability considerable cold, damp and cloudiness or mists with a diminished amount of light, and the effects of these conditions on man's clothing, housing and habits in general, the protective pigmentation of those who lived there became to a large degree unnecessary, and as organism will not tolerate for long anything that has become useless, the pigmentation of the northerners was reduced. Gradually or by mutations man grew lighter in these lands, until he came to constitute a blond "race." He has lost so much pigment that his skin has become "white," his eyes blue, and his hair light, ranging from light brown, yellow, or golden, to almost colorless. In the more central parts of Europe the depigmentation was less effective, and the result is the intermediary "Alpine" or "Kelto-Slavic" type; while in southern Europe, Asia Minor and northern Africa it was still less, leaving us the swarthy to brown, dark eyed and black haired Mediterraneans. It may be noted however that, except in full albinism, even the whitest skin, the lightest blue eye and the lightest hair still retain some of the old pigmentation. The blue eye in particular is not blue because of any new form of coloration but because the remaining pigment is limited to the posteriormost cells of the iris, the result of which is that the eye appears more or less blue on refraction; but viewed from behind the iris is not blue.

## III. EFFECTS OF MIXTURE

Through long residence in their respective regions and inbreeding, the three main types of pigmentation or rather depigmentation in Europe have become fairly fixed, so much so that even a prolonged residence elsewhere, such as that of some offshoots of the blond type in parts of the Mediterranean region and that of the dark Jew or offshoots of the Mediterraneans in northern Europe, has not been potent enough fully to efface either the blondness or darkness—though there has not been a complete preservation. There are however no sharp lines of demarcation, no break of continuity, between the blond and medium or the latter and the dark type; even where purest they pass on the boundaries imperceptibly into each other.

But due to original individual variation in the grade of the depigmentation, and to the great mixings of the European peoples before and especially within historic times, a large majority of the people of every larger country and even district either retain some of the old differences in these respects or have lost more or less their one time purity. A great majority of the present population of Europe are mixed-bloods—within the limits of the white race—and the mixtures have played havoc with pigmentation.

Yet the effect of the mixings in relation to pigmentation has been simple enough, consisting merely of an addition by the darker parent of so much melanin—or more strictly of so much more tendency to form melanin—to the progeny. In the blonds this tendency has been largely lost; in the mediums and darks partly to largely preserved; in the mixtures of darker strains with lighter it becomes more or less restored, and in consequence the progeny will show in varying degrees a darker pigmentation than the light parent. By admixture with a darker line the blond strain returns more or less towards its ancestral pigmented condition. Whether any of the first or second generation of the mixed progeny may, through a Mendelian form of heredity, be born once more pure light, medium or dark, as were their parents or grandparents, is not yet definitely known, but the plainly evident results of the mixture between different types of pigmentation is a large variety of intermediaries.

The effects of such mixtures are not manifested in the same way in all the involved parts. The skin-hair-eye pigmentation behaves in a large measure as a unit, but in interbreeding not infrequently this complex becomes more or less dissociated and its components enter into differing combinations with the pigmentation factors provided by the other



germ cell. The skin, hair and eyes show somewhat different tendencies in these directions.

In the skin the usual result of a mixture of two types of color is a uniform change, but the grade of this change may show considerable differences in different members of the resulting family. There are however also cases of irregular "blends." These may be witnessed occasionally in the admixtures of the white with the negro, and probably more frequently than we are generally aware of in the mixtures of darks and lights among the white people. The darker stain manifests itself in the form of more or less marked irregular areas or patches, or in larger or smaller "freckles." Permanent freckles have much more significance than they have hitherto received, and even passing freckles may occasionally have a phylogenetic rather than mere ontogenetic or casual significance. The characteristic freckled "Scotch skin" is much more probably a record of admixture of a darker with a light type in the past, than a sun-effect, or a meaningless individual or tribal peculiarity.

The hair in mixture behaves much like the skin. Generally the result is a "blend" or rather increased pigmentation more or less over that of the lighter parent. But not infrequently in mixed progeny with the lighter shades of hair, particularly in females where due to the length of the hair the conditions may be more easily appreciated, there may be detected strands of darker or lighter hair than the majority. An imperfect blend seems also to exist in some of the "sandy" or "rusty" reds. Individual tufts or locks of black or white hair are anomalies, though they may run in families.

The organs in which the most varied and interesting conditions result in consequence of mixture are, however, the eyes. The original human eye was probably hazel (or medium brown) to dark-brown. All the primates, all the colored races of man, and a considerable proportion as yet of the whites, have brown eyes. Such eyes in earlier times were doubtless associated with dark hair as well as a darker skin. But under the already discussed environmental conditions of northwestern Europe, acting through thousands of years, the protective brown pigment, no longer needed, was eliminated until it disappeared from the eyes, nearly disappeared from the skin, and was greatly diminished in the hair. The result so far as the visual organ was concerned was the blue eye, which became fixed by heredity. The blue eye as already noted, is not an eye wholly without pigment—that condition is present only in the eye of the full albino; neither is it an eye with any special pigment. But whatever pigment is present in the blue eye is located

only in the posterior columnar epithelium cells of the iris, whereas in grey, brown and the so-called black eyes pigment is found also in branching connective tissue cells interspersed between the bundles of connective tissue that form the substance or stroma of the iris, and even in the endothelial cells on the front of the iris.

If an unmixed blue-eyed person marries one with brown eyes, the result so far as the progeny is concerned may be one of several distinct conditions. In a small number of cases of such progeny, taken at large, it will be seen that the brown pigment owed to the darker mate has been distributed uniformly throughout the iris; and, according to its quantity, instead of a blue eye we shall have "greys," possibly some "greens," and light browns, the latter of which in a strong light may show a greenish tinge. But in the large majority of cases the distribution of the brown pigment in the iris will be more or less localized, and we shall have a *blueish* (never perfectly blue), greyish or greenish eye with a brown ring or area about the pupil, or brown "fly specks" or spots scattered over the iris, with a closer aggregation about the pupil. These cases constitute the large category of "mixed" eyes which are met with in the central and north European peoples of the present time, and which are very common among Americans.

#### IV. CLASSIFICATION

A detailed investigation on pigmentation in a highly complex population such as that of the United States, offers, due to the conditions enumerated above, some difficulties. There is a large number of shades in the color of the skin and hair which pass into each other without any lines of demarcation; and in the case of the eyes there are numerous mixtures that are not always easy of characterization. A correct appreciation and recording of the true conditions requires good eyesight in the observer, proper light, distance, and exposure (skin) in examination, a careful effort at distinguishing the true conditions, and the simplest possible thoroughly understood scheme of classification. Fortunately extreme details, except in some special researches, are not necessary, and the many shades met with may be grouped into a few categories that are not merely sufficient for ordinary scientific purposes, but are readily intelligible even to a non-scientific man or woman.

The most practical classification for white people of the American type as found by the writer, both through considerable experience in examination as well as in the analysis of the obtained records, and one which was therefore used throughout in these studies, is as follows:

## PIGMENTATION

## SKIN

<i>Light</i>	<i>Medium</i>	<i>Dark</i>
(blond, pale-rosy)	(all between light & dark)	(swarthy, dusky)

## HAIR

<i>Lights proper</i>	<i>Light Brown</i>	<i>Medium</i>	<i>Dark</i>	<i>Black</i>	<i>Red</i>
(blond; yellow and golden; light brown, near blond)	(not blond)	(medium brown, medium dark)	(dark brown, dark, near black)		(sandy- light brick- salmon- dark- or chestnut- red)

## EYES

<i>Pure Lights</i>	<i>Intermediates, Mixed</i>	<i>Pure Browns</i>
blue (pure) (light, medium, deep)	green (pure) grey (pure) (brown spots, splotch- es, ring, or tinge, in lights; in browns plain tinge of grey or green- ish)	(light, med- ium, dark)

In general the pigmentation of the parts examined shows considerable conformity. A light skin will be associated with blond or yellow hair and light to medium blue or greenish eyes; red hair goes generally with a light to pale rosy skin and a light to medium blue or greenish or mixed eye; and a dark brown eye is invariably associated with dark to black hair while the skin will range from slightly brunet to dark. As a rule also the unmixed medium and dark types breed true, the lights lights, the darks darks, though the range of exact shading in each is fairly extended. But those with medium pigmentation seem less stable and harmonious, and the usually large category of mixtures presents frequent smaller or greater disharmonies and irregularities.

## V. COLOR OF SKIN

The observations on the skin in the present studies, extended to 200 "Old American" males and 250 females without selection. The gross results are as follows:<sup>4</sup>

<sup>4</sup> It is self-understood that non-instrumental observations such as these, however carefully made, cannot claim mathematical precision, and would probably differ slightly from observer to observer; but these differences, with equally instructed students, could not be great enough materially to affect the general results.



## COLOR OF SKIN

Skin	MALES (200)		FEMALES (250)	
	Number of Subjects	Percent	Number of Subjects	Percent
Light (perceptibly lighter than medium)	1	—.5	13	5.2
Medium	135	67.5	188	75.2
Swarthy (perceptibly darker than medium)	55	27.5	42	16.8
"Scotch" (freckly), otherwise medium	9	4.5	7	2.8

The above figures show that in a little over seven-tenths of the cases in men and in over three-fourths of the women, the color of the skin of the Old Americans may be classed as medium; that, particularly in the males, there is in health but a small proportion of lights; but that a very appreciable minority possess skin that, while far from really dark, is perceptibly "swarthier" or darker than the medium.

There is throughout the series a somewhat greater inclination towards pigmentation of the skin among the males than among the females. This to some extent is probably connected with more exposure among the males, but it does not seem to be due to this alone. The whole showing is rather noteworthy, for as will be seen presently it is not paralleled by the pigmentation of other features.

A study of the correlation of the skin color with that of the hair and eyes gives results that are very interesting. There were recorded one "light" skinned male and thirteen females, and the corresponding hair and eye colors were:

## CORRELATION OF COLOR OF HAIR AND EYES WITH THE COLOR OF THE SKIN IN OLD AMERICANS

## LIGHT SKIN

Number	Skin Perceptibly Lighter than Medium	Blonds	HAIR			EYES		
			Blonds	Reds	Light Brown	Light Blue	Medium Blue	Greyish or Greenish Blue
1	Male.....				1	1		
13	Females.....	6	4	3	3	3	5	5
14	Subjects, percent	43.	28.5	28.5	28.5	28.5	35.7	35.7

All the subjects with light skin are, it is seen, blonds or near blonds, with a few reds. There appears therefore to be a positive correlation between a lighter than ordinary skin and light hair and eyes. Wherever there is a subpigmentation of the skin, there is also in our subjects a feeble pigmentation of the eyes and hair. But the rule does not work both ways—subjects with light hair and eyes do not always or even very often have also a lighter than medium epidermis.

On the other side of the "medium" we have the more or less swarthy, dusky or faintly tawny skins, and the correlation of hair and eyes with these discloses some curious conditions.

CORRELATION OF COLOR OF HAIR AND EYES WITH THE COLOR OF THE SKIN IN OLD AMERICANS

DARKER SKINS

Number	Skin Perceptibly Darker than Medium	HAIR					EYES			
		Lights	Medium	Dark to Black	Reds	Lights	Browns			
		Blond	Light Brown			Blue, Grey, greenish Mixed	Light Brown	Medium Brown	Dark Brown	
55	Males		(2) 3.6	(16) 29.1	(37) 67.3		(34) <sup>1</sup> 61.8	(7) 12.7	(12) 21.8	(2) 3.6
42	Females		(1) 2.4	(8) 19.	(33) 78.6		(21) <sup>1</sup> 50.	(3) 7.1	(13) 31.	(5) 11.9
97	Subjects:		3.1	24.7	72.2		56.7	10.3	25.8	7.2

<sup>1</sup> Mostly "mixed" (blue or greenish or greyish with more or less marked traces of brown).

The above shows that in the darker persons there exists a very marked correlation between the color of the skin and that of the hair. There are no "blonds" in the men or women with darker skins and unexpectedly also no "reds," which points to a rather close relation of these shades; and there is a very large proportion of darks to black. Also, throughout, there is an evident tendency towards more darkness of hair and eyes in the females than in the males, which however, as will be shown below, does not apply alone to this class of cases.

As to the eyes, the correlation of their color with that of the skin is plainly less than with the hair. A good proportion of both men and women with a darker skin and dark hair have blue, greenish, grey and especially mixed eyes; but there is also a considerable proportion of

browns, much above that in the Old Americans at large. The women show again a greater tendency in this direction—they have less “lights” and light browns, but decidedly and progressively more medium and dark browns. Why this should be so is not yet quite clear, but we shall return to the phenomenon, which seems to be generalized among all whites, on another occasion.

The above correlations between brunet skin and the color of the hair and eyes, may be shown still more clearly by comparing the percental representation of the different classes of shades of the hair and eyes in those with swarthy skins to the whole number of subjects in our series:

COLOR OF HAIR AND EYES IN SUBJECTS WITH SKIN PERCEPTIBLY DARKER THAN MEDIUM COMPARED WITH THAT IN THE SERIES AT LARGE

HAIR					EYES			
Blonds	Reds	Light Brown (Not Blond)	Medium	Dark to Black	Blues, Green, Grey Mixed	Light Brown	Medium Brown	Dark Brown
Percental relation to proportion in the whole series:								
Males. . . . .		22.	58.	279.	74.	310.	225.	124.
Females. . . .		24.	44.	262.	65.	203.	209.	243.

Among those with darker skins there are, in respect to hair, no blonds or reds, only a little over one-fifth as many light browns, and approximately one-half as many medium browns as in the Old Americans taken as a whole, but nearly three times as many darks-to-blacks. As to eyes the darker skinned show one-fourth to one-third less lights, but more than twice as many browns, two to three times as many light browns, over twice as many mediums and over once to twice and a half as many darks. A greater tendency to eye pigmentation is once more apparent here in the women.

The meaning of these conditions tends to be that a normally darker skin in the American and doubtless other whites is generally an expression of not a localized but a systemic tendency towards darker pigmentation, and as such is probably of phylo- rather than ontogenetic significance; that it is, in other words, a survival of a darker ancestry rather than an individual peculiarity. Just how much more or less of the darker skins there are in the Old Americans than among other whites, we shall only be able to tell from similar studies among these other groups.

The “Scotch skin” is a medium white skin with numerous light and rather large and irregular “freckles” on the exposed parts. On the face



these "freckles" extend to the forehead. It is highly characteristic of a proportion of persons of Scotch derivation and that among the Old as well as recent Americans. The subject deserves a detailed study of its own. As already mentioned, there is a strong indication that these "freckles" are merely the remnants of a darker skinned strain admixed in the dim past into the Scotch people.

#### VI. THE HAIR

The records on pigmentation of the hair are much more numerous and comprehensive than those on the skin. They apply to 1,009 men and 914 women.

The method, based on considerable experience and preliminary work, was to subdivide the large range of colors into as few as possible definite classes, and then to use common sense, with good indirect light, plenty of time, and due care, in determining the shade. In general this method is preferable to that of comparing the hair with given standards, for that takes longer and among such a mixed population as ours we would never have enough standards. It is true that it is not easy in such a visual method to get rid of all personal equation, but the amount of such an equation may be very much reduced and be rendered practically insignificant by due instruction or understanding of the subject, with practice. The final classification of the shades is not arbitrary. We begin with the safe units of "black," decidedly "light" and unmistakably red. This leaves a large category of intermediate grades, all of which fall however into three subdivisions, namely, light brown (not blond), medium (or "medium brown"), and dark (or "dark brown"). A large majority of cases will readily and unmistakably be placed in one or another of these classes by every properly instructed observer. This will leave, as possible sources of error, only the transitional shades, for there are between none of the colors any definite lines of demarcation. These cases, with a careful student, will amount to approximately 10 percent with the blonds, 20 percent with the light browns (not blond), mediums, darks and reds, and 5 percent with the blacks. When we add to this that by the law of chance, other things (such as the training of the observers, etc.) being equal, as many of the "uncertains" in each category will be recorded right as wrong, and that those recorded wrong in one class will be counterbalanced by the wrongs of the next, it may be seen that unless there is a lack of due instruction, negligence, or the development of some special bias on the part of an observer, his records on any large series of individuals will be substantially correct.

and comparable with those of all other similarly instructed and careful workers. That this is so may be shown in our series in Virginia. In a camp of U. S. Engineers, near Charlottesville, after due initiation the work was left in the hands of Dr. Robert Bennett Bean of the University of Virginia. The results, except for a slight difference which developed in recording the eye colors, were practically identical with those of the author as far as the latter applied to the same territory.

The study of hair color among the Old Americans fully confirms previous observations on the change in the color of the hair with age. Except in those with the darkest shades the hair in general shows from infancy on to adult life and in many cases even through a part of the adult life, a progressive darkening. The lightest hair in an infant may thus eventually become light, medium or even fairly dark brown—though not black. Even the red hair darkens or loses its purity. The golden also is unstable. A small series of near-adults found by the writer among the teachers shows, as will be seen later on, a very perceptibly higher grade of lightness than that of the fully adult of the same class. In some persons the darkening of the hair seems to progress until the time when the first traces of greying (in individual hairs) commences. This progressive darkening of the hair has been observed in all white people with hair lighter than black. Its causes are not yet well understood. It means of course a progressively greater production of the hair pigment, but whether this is due to environmental stimuli, metabolic changes or phylogenetic influence, is not as yet determined. There are decided individual variations in this respect, and possibly also sexual, locality and other differences. The whole subject deserves a separate, deep-going investigation.

Our records on the distribution of hair color among the Old Americans, as finally tabulated, are as follows:

OLD AMERICANS: COLOR OF HAIR

	Lights Proper	Light Brown (not blond)	Medium (medium brown)	Darks (dark, dark brown, near black)	Black	Reds
	<i>Per cent:</i>					
Males (1009)	5.3	16.	50.	25.	1.1	2.6
Females (914)	6.9	14.2	42.9	29.8	1.3	4.9

These figures are striking in more than one respect. Over three-fourths of the adult Old Americans have hair ranging from medium

to dark and black, while but one in 14.5 among the females and one in near 16 among the males is in hair truly blond. The females as contrasted with the males show a few more blonds and more reds, but also more darks, while the males give a predominance of the lighter and medium shades of brown.<sup>5</sup> The females show the greater diversity.

However, an even closer insight into the conditions is possible. The following data give us the more detailed colors:

OLD AMERICANS: COLOR OF HAIR, DETAILS

	Blond	<i>Lights Proper</i> Golden or Yellow	Light Brown (near blond)	Light Brown (not blond)	Medium	Dark	Black	Reds
	<i>Per cent:</i>							
Males...	1.2	0.6	3.5	16.	50.	25.	1.1	2.6
Females	0.9	1.6	4.4	14.2	42.9	29.8	1.3	4.9

The golden and yellow among the females are seen to be more than twice, the near-blonds once and a half as frequent as in the males. The males, as seen before, predominate in the submedium and medium brown. In the darker shades the females have a larger representation than the males, and this domination, as will be seen later on, is of significance. It may also be stated in this connection that the reds in the females are mostly the more or less golden reds and again the darker reds.

All the above establishes the facts that: (1) The Old Americans are, so far as hair color is concerned, only exceptionally blond, but commonly medium to brunet; and that the females show a greater proportion of golden, near-blonds and reds, but also of dark browns and blacks, than the males. The males are more intermediate. Possibly there is in the females a clearer show of varied ancestral conditions, while the males show greater blend.

Tested by subdivisions of 100 or more, the above data hold fairly good, so that they may probably be regarded as a pretty true expression of the conditions among the territorially mixed Old Americans in the eastern half of the United States. But in localities where some definite group of immigrants has settled, such for example as the Scotch, Penn-

<sup>5</sup> It is self-understood that all possible care was exercised not to include any cases of hair changed artificially. Fortunately this is not frequent in this class of people, except perhaps among some of the older persons where the object is to mask greyness and simulate the natural shade.



sylvania Dutch, etc., the conditions will differ in harmony with the original pigmentation of the group. The ancestral influence appears everywhere to be very tenacious.

The above results indicate that blondness is not characteristic of the Old Americans. There is in addition but a modest proportion of reds and very few true blacks. Half of the people are medium, three-quarters are medium to dark haired. The affinity of the Old Americans with the Nordic blonds is seen from this to be rather secondary, unless substantial changes in the direction of greater pigmentation have been realized in the Americans since their sojourn on this continent—which however, as will be seen later, is contra-indicated by facts.

The records on the two sexes show, it was seen, interesting differences, though the total amount of pigmentation in the two sexes is about the same. The women evidently preserve better the different ancestral conditions from which the mixture represented now by the Old Americans arose, while the men show more fusion, more blend. Similar facts, including the preponderance of the darker shades in the females, have been observed elsewhere. The English observers in particular have shown that the women of Great Britain tend to be darker than the men. From Beddoe's data, Parsons<sup>6</sup> found that among the English the females were, according to regions, darker-haired than the men by from 0.6 to 6.5 per cent. Fleure and James<sup>7</sup> found similar conditions, that is, a greater predominance of darks among the females than among the males, in Wales; and Gray with Tocher<sup>8</sup> in Scotland. The latter have also shown further by their studies on Scotch children<sup>9</sup> that the greater darkening of the females is a post-natal, or rather post-infantile phenomenon.

For purposes of sexual as well as groupal or racial comparison, it would be very convenient if it were possible to reduce the different classes of hair color to approximate numerical values. It seems well worth while to make an attempt in this direction. Let us take pigmentless hair as 0, black hair as 100 and medium hair as 50. It will then be reasonable to assign to the "Light brown (not blond)" class the mean value of 25, and to the Light or Blond (with golden, yellow and light brown near blond) that of 12.5; while the "Darks" will be 75. For

<sup>6</sup> *J. Anthropol. Inst.*, 1920, L, 166-'7. See also Beddoe, J.—*Anthropological History of Europe*, 1912 ed., 98.

<sup>7</sup> *J. Anthropol. Inst.*, 1916, XLVI, 49.

<sup>8</sup> *J. Anthropol. Inst.*, 1900, XXX, 109.

<sup>9</sup> *Ibid.*, 115.

red hair, the most difficult to gauge, we may perhaps assume the mean value of 35. These values, which are not as arbitrary as they might seem, will be seen better in a little table:

## ASSUMED VALUES OF HAIR COLORS

Lights proper (blonds or near)	12.5
Light brown (not blond)	25
Medium	50
Dark	75
Black	100
Red	35

If now the records on hair pigmentation be presented in these values, we obtain the following:

OLD AMERICANS: UNITS OF HAIR PIGMENTATION  
(Per 1000 Subjects)

SHADE	MALES	FEMALES
Lights proper.....	662	862
Light Brown (not blond)....	4,025	3,550
Medium.....	25,000	21,450
Dark.....	18,750	22,350
Black.....	1,100	1,300
Reds.....	910	1,715
	50,447	51,227

Males : Females :: 100 : 101.5

The females are, on the whole, approximately 1.5 per cent darker than the males. This proportion will naturally differ with region, as the actual records differ, but the female always shows a greater total.

GEOGRAPHICAL DIFFERENCES.—Attention was given from the start of the studies to possible indication of regional differences in pigmentation, especially between the north and the south; but nothing striking or definite became manifest in this direction. What differences do exist became apparent only after the data were reduced to percentages. The results, so far as the hair is concerned, are shown in the following table:

REGIONAL DISTRIBUTION OF HAIR COLOR IN THE OLD AMERICANS  
MALES

Region	Lights (Lights proper & Light Brown)	Medium	Darks (Dark to Black)	Reds
New England <sup>10</sup> (65) . . . . .	26.1	55.4	16.9 <sup>11</sup>	1.5
Middle East & Mixed (449) . . . . .	22.4	45.2	29.6	2.7
South (D. C. & Southward) (369)	22.3	48.	27.1	2.7
Appalachians (Tenn. & neighboring) (126) . . . . .	12.7	69.8	15.1	2.4

FEMALES

New England (41) . . . . .	39.	34.1	26.8 <sup>11</sup>	
East & Mixed (339) . . . . .	21.	37.2	36.3	5.6
South (534) . . . . .	19.8	47.2	28.1	4.9

BOTH SEXES

	Blonds and Moderately Light	Medium	Dark (to Black)	Medium & Dark	Red
New England (106) . . . . .	32.6	44.8	21.9	(66.7)	0.7
Middle East & Mixed (788) . . . . .	21.7	41.3	32.9	(74.2)	4.1
South (903) . . . . .	21.1	47.6	27.6	(75.2)	3.7

The regional differences in hair color, it can be seen from the above figures, are not very material, yet there are differences, and in a measure, as to between north and south, they bear out the common notion. In both sexes among the "Yankees" there is a larger proportion of lights and a somewhat smaller percentage of darks than in the south. The hair among the Old Americans of the South may therefore be said to be less frequently blond and somewhat more frequently dark than that of the same class of the population in the New England region. But the Old Americans of the middle east and of mixed-state parentage agree very closely with those of further south, showing if anything even a good trace more of darks, though if we take the mediums and darks together the proportions are almost identical. In all the regions, it is noticeable, the females present a larger proportion of darks than the

<sup>10</sup> All American ancestors of the subject lived in the regions here given, not merely the individual recorded.

<sup>11</sup> No blacks.



males, indicating a deep-rooted tendency in this direction. In the New England States there appear also more female than male blonds and less intermediates. The females show less intermediates throughout the series.

A very interesting locality group is that of the more northern Appalachian mountaineers. They show the least lights as well as darks and by far the most intermediaries of any of the groups. This is in all probability the result of a more thorough intermixture due to interbreeding. The mountaineer, as long as he remains in the mountains, marries almost invariably in the mountains. The group affords a good indication of what would very likely eventually take place in the whole body of Old Americans were there no mixture from outside of their own circles.

Our conclusions may be summarized in the statement that the ordinary conception of the southern Americans being darker than the "Yankees" or New Englanders, is sustained to but a moderate extent; that there is no appreciable difference as relates to hair color between the Southern and Old Americans at large; but that more isolated groups in the south and possibly also in the north may be expected to show more or less exceptional conditions according to ancestry and grade of intermixture or inbreeding.

RED HAIR.—The subject of red hair, like that of age changes in hair color, is not yet fully understood and needs a thorough reinvestigation. The two prevailing theories are first "that it is a variant of fair hair because it so often accompanies a freckled skin and light eyes; the other that it shows a mixture between a light and a dark race" (Parsons, *o. c.*, 182). The English records "seem to help both theories . . . Scotland and the north of England are the fairest parts of the kingdom and it is there that red hair is most marked; but it is also well marked in Wales and in parts of Ireland, especially Kerry, where the nigrescence is very high."

From the English records it would appear that there is no regular sex difference in the proportion of redness. In 66 locality groups (Beddoe's observations), 30 show a larger percentage of reds in the females, 32 in males and in 4 the proportion was equal. The whole group of Beddoe's males give a red hair percentage of 4.4, the equally large group of females 4.9. From the same data Parsons finds that "red hair is more common in the upper than in the lower classes," to which he adds (*o. c.*, 182), that according to his own observations not only is red hair commoner in the upper classes, but that these classes have also an altogether

lower index of nigrescence, in other words are less pigmented, than the lower.

In the course of the study on the Old Americans the impression grew that the category of "red hair" is not wholly homogeneous, and that it probably includes more than one related condition. There are "reds" in which the whole system participates in the phenomenon. The eyes are pale, light blue or greenish, the skin is akin to the rosy skin of the albino, the breast areola is devoid of pigment, the mucous membranes are light red. Also these individuals are generally believed to differ more or less mentally as well as in their predispositions to certain ailments, from the average of the population. And there are other "reds," generally of the darker shades, in whom the rest of the system does not participate, or participates but little in the condition, is not peculiar in other words to any marked extent. It may be that the differences are merely those of degree; we shall not know until the subject is exhaustively investigated by itself. A study of the blood may one day help to clear matters.

Red hair, or at least some of it, also changes with age. Some such hair grows nearer to brown, loses in lustre and beauty and loses the gold of the red; while other simply darkens.

A relation of red hair to the brown is very evident. Most brown hair in certain light shows a more or less marked trace of red, and the moustache of brown-haired men is generally more or less "grizzly" or "rusty," that is nearer red. A relation to the blonds is not apparent, except perhaps through the golden red. It is a golden red which accompanies all shades of color down to dark brown. On the whole, red hair seems to imply a partial loss of pigment from the hair, a loss limited possibly to the outer layers of hair cells. It is a phase of depigmentation, not a variant of blondness; and the red pigment, if it exists as such, appears to be only a variant of the ordinary brown pigment. The relation of red hair to the color of the eyes will be dealt with later. The relation of red hair frequency to social status, as believed to exist in England, did not become apparent among the Old Americans where there is little class distinction. Our highest group socially (on the whole) gave for the men the frequency of 2.2, our lowest 2.0 percent of red hair; while what could be taken as an intermediate group showed 3.0 percent. Geographically, the least red hair (men but 1 case, women 0) occurs in our series of the New England States; the most (men 2.7, women 5.6 percent) in the middle eastern States and in those of mixed parentage from more than one State.

*Eyes in the Red-haired.* An interesting inquiry was that into the association of eye-colors with red hair. It is common knowledge that red hair is generally associated with light eyes, yet the matter seems never to have been subjected to a rigorous test. Our records disclose the following conditions:

Eye Color in Individuals with Red Hair  
BOTH SEXES

Light	Blue Medium	Deep	Greenish	Greyish	Mixed	Light	Brown Medium	Dark
%	%	%	%	%	%	%	%	%
6.2	16.9		7.7	6.2	56.9		6.2	
23.1								
		Lights 37 Percent			Mixed 57 Percent		Browns 6 Percent	

A little over one-third of the red-haired Old Americans have light eyes. A little less than a half of these (46 percent of the group or 17 percent of the whole) are "light eyes—light reds," and to somewhere near that extent only may we assume red-hairedness to be directly associated with blondness. In the rest of the cases with pure light eyes the hair was medium to brownish- or chestnut-red.

A large proportion of the eyes in the red-haired are mixed. In the whole series studied the proportion of mixed eyes was approximately 48 percent; in the red-haired it is 57 percent, a plain excess for the latter. This excess as well as the whole proportion of mixed eyes in the red-haired points to the conclusion that red-hairedness is strongly associated with mixture of blonds and brunets; that, in other words, it represents partial depigmentation or repigmentation.

In a small percent of our cases red hair was associated with eyes that were pure medium brown. The hair ranged in these individuals from light- and salmon-red to brown-red and chestnut-red. As the brown eye is believed to be dominant over the lights in mixtures, the mixture of types in these cases may have remained occluded; but a partial depigmentation of the hair from any other cause might possibly have been sufficient. We should scarcely be justified, in other words, without much further inquiry into the subject, in regarding red hair in the progeny of brunet parents as an absolute proof of admixture into the family of either a red- or blond-haired outsider.



The conclusions concerning red hair may be briefly summarized as follows:

1) Red hair appears to be merely a form of depigmentation (or partial repigmentation).

2) In traces and minor degrees it is a far more common condition than generally appreciated.

3) In a large majority of cases it is connected with the mixture of light with darker types of individuals.

4) In a minority of cases it may probably exist without mixture as a variation in the direction of depigmentation (or partial repigmentation).

5) There are red-haired individuals in whom the depigmentation involves the whole system, approaching more or less albinism and an abnormal condition.

6) There is no line of demarkation between red hair and golden on one side, and red hair and the different shades of brown on the other.

#### ANOMALIES OF HAIR PIGMENTATION

Anomalies of hair pigmentation relate to uniformity in color. But little in these respects was noticed among the Old Americans, if we disregard slight to moderate irregularities in shading (lighter or darker strands).

Two individuals, however, one male and one female, showed different colored tufts (or locks) of hair. The female had a white lock in dark hair above the forehead; the male a black tuft in otherwise uniform medium hair above the fore part of the right temporal region. In one female, 45 years old, most of the hair on the right side was medium brown, while the whole left side was (naturally) perceptibly darker.

#### VII. COLOR OF THE EYES

To properly gauge the eye color is a fairly simple matter in some groups of the white race, such as the pure Nordics or the Mediterraneans; but it becomes a difficult task in mixed strains such as that of the English and especially the Americans.

To approach the subject properly, we should be clear to start with on the elementary question as to what is eye color. The many shades of eyes to be met with, as with the hair, do not represent so many different pigments, but only so many grades and varieties of pigmentation and depigmentation. The eye pigment as that in the skin and doubtless also in hair, is there for protection, and though it may not be strictly simple or homogeneous, it behaves essentially as one pigment which is

distributed in small granules in the lining and certain interstitial cells of the iris. The color of the iris is a reflection of light according to the quantity, density and distribution of the pigment granules. If these granules are in considerable quantity and distributed throughout the endothelial, interstitial and even epithelial cells of the iris, the eye is brown to "black," the shade differing with the total quantity and density of the granules. With the maximum quantity the eye is black as in some negroes; on the other hand as the quantity of the pigment decreases we have gradually a lighter and lighter shade of brown until this passes into light brown, then greyish or greenish brown, then bluish or greenish grey and finally, when no pigment remains in either the anterior lining or the interstitial cells of the iris, with but little in the endothelium, the eye is blue.

As in the skin and hair, so here again there are no lines of demarcation between the various shades, and we must make a somewhat arbitrary classification. In this we may recognize to start with two great groups, the pure eyes and the mixed. The pure in their turn are capable of three subdivisions, the brown, the blue, and the lights other than blue (grey, greenish); and the browns and blues are further subdivisible each into the dark (or deep), medium and light. Intermediary tinges appearing different under varying conditions of light, health, mental state, occur and can only be classified with difficulty.

The "mixed" eye is strictly speaking a misnomer. It does not mean an eye with a mixture of any two distinct pigments, but an eye resulting from a mixture of a brown-eyed with a lighter parent in which the parental conditions are not well blended. Have the eyes of the parents been different, the eyes of some of the progeny may show a darker or lighter blend of the parental colors; the eyes of some may show one or the other parental shade dominating with the other in recession; but the eyes of most of the children will bear traces of the mixture in an unequal distribution of the pigment derived from the darker parent.<sup>12</sup> It is these last eyes alone that the observer can designate as "mixed."

The "mixtures" are of many kinds, but they are all characterized by some imperfection in the distribution of the brown. This may occur as a narrower or broader ring about the pupil; as a greater or lesser disper-

<sup>12</sup> The laws of heredity in this connection are still under investigation. See Davenport (C. B.)—Heredity of Eye-Color in Man. *Science*, 1907, XXVI, 589; Hurst (C. C.)—On the Inheritance of Eye-Color in Man. *Proc. R. Soc.*, 1908, 80:85; Boas (Helene M.)—Inheritance of Eye-Color in Man. *Am. J. Phys. Anthropol.*, 1919, II, 15-20.

sion of brown spots, with an aggregation about the pupil; in the form of brown patches or stains of color over the iris, with lighter regions; and rarely in the form of a single brown segment radiating from the pupil to the periphery of the iris.

From the above it will be seen that the only rational classification of eye color can be about as follows:

EYE COLORS	
(Largely) Depigmented, pure	Blues { light medium deep
	Grey Greenish Greyish-blue Greenish-blue
Pigmented	Brown { light medium dark or near black
Mixed	Black
	Light brown
	Grey { With rings, spots, patches, areas, stains or segments of brown
	Greenish or Blue

All records on eye color, however carefully made, necessarily bear the following imperfections: A small number of the apparently pure light browns, and other-than-blue lights, will belong to the category of only apparently and unstably (in relation to progeny) pures; they are mixts in which the mixture is not clearly perceivable. A small proportion of the medium browns will be in the same category. A superficial observation in addition will inevitably result in classing many of the mixts as pures. The classes freest of error will be the pure blues and the darker browns, in which it will merely be a question of classification errors along the boundaries.

There have been many former attempts at a satisfactory classification of eye-color, and several "standards" have been made by which to record these colors. Being largely empirical, however, none of them, either classifications or standards, are fully satisfactory. In the present studies reliance was placed on the above analysis of the colors, on due regulations of the procedure, on large practice, and on constant care. All eyes were examined in clear light, at the distance of best vision, the "reading distance." The use of artificial standards, after



sufficient expertness was acquired, was found unnecessary and hindering rather than facilitating the examination.

With all the above regulations and precautions it is certain that the results on eye color here recorded are still imperfect; though they are probably as near correct as they can be made under present conditions.

The number of records on eye color among the Old Americans is the same as that on the hair, namely 1009 males and 914 females; and the total data show the following results:

OLD AMERICANS: COLOR OF EYES

	Pure Lights	Mixed	Pure Browns
	<i>Per Cent:</i>		
Males (1009).....	31.	52.5	16.5
Females (914).....	24.1	55.9	20.

More than half of the eyes among the Old Americans are mixed, in general a light of some sort with specks, ring or other plain traces of brown; approximately one third in males and one fourth in females are pure lights, and one sixth in males with one fifth in females are pure browns. The females have less pure lights and more browns, showing again the tendency towards somewhat greater pigmentation.

The above data contrast in an interesting way with those on hair:

OLD AMERICANS: CONTRAST OF HAIR AND EYE COLOR

## HAIR

	Lights <sup>1</sup>	Medium	Darks
	<i>Per Cent:</i>		
Males.....	22.2	50.8	27.
Females.....	22.7	44.6	32.7

## EYES

	Pure Lights	Mixed	Pure Browns
Males.....	31.	52.5	16.5
Females.....	24.1	55.9	20.

There is seen to exist a marked general correspondence of lights with lights, medium hair with mixed eyes and of darks with darks; but already

<sup>1</sup> To each category is added one third of the reds.

these gross figures show more light eyes than light hair and more dark hair than dark eyes, indicating that on the whole the hair tends towards a greater pigmentation than the eyes. It is known that this tendency, while universal, is particularly noticeable in certain districts or among certain racial groups in Europe. The Irish are a good example.

Additional features of interest so far as the eyes of the Old Americans are concerned, are shown by a more direct classification:

OLD AMERICANS: COLOR OF EYES, DETAILS

	Pure Lights					Mixed	Pure Browns		
	Blues			Other Lights			Light	Medium	Dark
	Light	Medium	Deep	Greenish-Blue & Greenish	Greyish-Blue & Grey				
	<i>Per cent.</i>								
Males	7.9	14.8	1.1	2.2	5.	52.5	4.5	9.3	2.7
Females	2.9	15.2	1.9	1.4	2.7	55.9	2.2	13.8	4

Light blue eyes are more than twice as common in the males as in the females; the medium blues are about equal in the two sexes, the deep blues are nearly twice as frequent in the females as in the males. There is therefore a tendency in the males towards the lighter, in the females towards the darker shades of blue. This is in all probability connected with the general tendency of the females towards a greater eye pigmentation, which is shown very plainly by the browns. The females show also less of both the pure greenish and the greyish eyes, which most likely is equally due to the phenomenon just mentioned.

We may well ask in this place just why this tendency towards greater pigmentation in the female hair and eyes should exist. So far as the writer knows, while the fact has been recorded again and again, no serious attempt has yet been made at showing the reason. Yet there must be reasons, and judging from the generality of the tendency, they are more likely to be of inherited than of environmental nature.

These are the facts that may have a bearing on this question: In the section on skin pigmentation it was seen that the skin of the male is more frequently darker than medium than happens among the females; should this fact be substantiated elsewhere, we would be justified to assume that the skin in the male takes care on the average of a somewhat larger quantity of the pigment produced in the body, while in the female, should she produce proportionately to her weight as much as

man, the surplus would be likely to go into the eyes and hair. In addition, the male discharges a substantial quantum of pigment through his beard, moustache and greater body hairiness, as well as through the hair of the head, for due to the frequent cuttings a man produces on the average more hair on his head than a female. All this disposes in the male of a considerable amount of the pigment formed in the body, so that if the sexes produced the same or nearly the same amount per pound of active tissue, there would be a surplus of pigment in the female which would inevitably, it seems, affect the pigmentation of both the eyes and the hair. There is no indication that there is any greater production of pigment in the female, but she differs slightly in the manner of its disposition and elimination.

The relative pigmentation of eyes in the two sexes may also, as in the case of hair, be presented in the form of values. If the subject is carefully weighed it will be found that about the following approximate values may be assigned to the different eye colors:

### ASSUMED VALUES OF EYE COLORS

<i>Pure Lights:</i>	Blues	{	Light	10
			Medium	20
			Deep	25
	Greenish			15
	Grey			30
<i>Mixed:</i>				50
<i>Pure Browns:</i>		{	Light	65
			Medium	75
			Dark	85

Arranging our data on this basis, we obtain the following interesting results:

UNITS OF EYE PIGMENTATION  
(Per 1000 Subjects)

Shade	Male		Female	
<i>Pure Lights:</i> Blues { Light Medium Dark	790 { 2,960 { 275 {	4,025 {  330 {	290 { 3,040 { 475 {	3,805 {  4,825 {
Greenish & Greenish-Blue			210 {	
Grey & Greyish-Blue		1,500 {	810 {	
<i>Mixed:</i>	26,250	26,250	27,900	27,900
<i>Pure Browns:</i> { Light Medium Dark	2,925 { 6,975 { 2,295 {	{ 12,195 {	1,430 { 10,350 { 3,400 {	{ 15,180 {
TOTALS:	44,300		47,905	

Eyes—Males : Females :: 100 : 108.1

Hair—Males : Females :: 100 : 101.5



A few words only are necessary to the above figures. The pigmentation of the eye among the females in the Old Americans is to that of the males as 108 to 100; the female eye in other words is approximately 8 per cent darker. The rest of the differences parallel what has already been shown by the simple percentages. It is interesting to observe that the differences in the eye pigmentation exceed those in the hair. The same phenomenon, as will be seen later, has been observed in England and is probably true elsewhere.

REGIONAL DIFFERENCES.—As with the hair, so with the eyes, the main interest as to regional differences in pigmentation attaches to the question of differences between the north and south. The following table shows these relations:

REGIONAL DISTRIBUTION OF EYE COLOR IN THE OLD AMERICANS

Region	BOTH SEXES TOGETHER		
	Pure Lights	Mixed	Pure Browns
	<i>Per cent:</i>		
New England.....	32.8	48.	19.2
Middle East & Mixed <sup>1</sup> .....	24.4	55.8	19.8
South.....	30.8	52	17.2
Appalachians (Tenn. & South)	24.6	62.8	12.6

<sup>1</sup> Part of forbears from northern, part from central or southern states.

The differences in eye color between the south and the north and between either of these and the middle states, are seen to be slight only, even less than with the hair. There are a few more lights, but also a few more browns among the Yankees than among the Southerners, but the differences are too small to be given any special significance. There is however, as with the hair, a marked difference shown by the Appalachian mountaineers, among whom there are less pure lights, less pure browns and a larger proportion of mixed shades. It was seen (p. 115) that precisely the same conditions were observed in this special group in relation to hair colors.

CORRELATION OF EYE AND HAIR COLOR.—In order to make the presentation of the records here dealt with as clear as possible, it will be necessary to show, besides the separate data on hair and eyes, also the associations of conditions. Not every light eye is accompanied with light hair, thereby enabling us to class the subject as blond, nor every dark hair with a dark eye, giving us a well-marked brunet. There are

many exceptions in fact to such associations. Conditions were found in brief as follows:

OLD AMERICANS: CORRELATION IN EYE AND HAIR PIGMENTATION

BOTH SEXES

EYES	HAIR			
	Lights	Medium	Darks	Reds
	<i>Percent (round numbers)</i>			
Pure Lights.....	37.5	48.	12.	2.5
Mixed.....	20.	50.	26.	4.
Pure Browns...	9.5	43.	46.	1.5

Persons among the Old Americans with light eyes that show no mixture have in nearly two-fifths of their number also light hair, while in approximately one half of the cases the hair is medium, and in nearly one-eighth it is dark. Red hair occurs, but in slightly lesser proportion than in the general average.

Those with mixed eyes (lights with more or less marked traces of brown), have light hair in only one fifth, medium hair in one half and dark hair in one fourth of their number. In respect of both the light and dark hair they start, as might be expected, practically midway between the pure light-eyed and pure brown-eyed series. But they show more mediums, *i. e.* more blonds, and decidedly more reds. The latter condition demonstrates the close association of perhaps as many as half of the cases of red hair with mixture of the lighter and the darker racial elements in the population.

The brown-eyed show but a few light-haired and these generally of the least blond variety; they have, somewhat less frequently than either the light or the mixed-eyed, hair of medium shade; but they show in nearly half the instances dark hair to black. Also they show the least reds and those only in association with the lighter browns of the iris.

Still further insight into these conditions may be obtained if the data are studied with a little more detail:

OLD AMERICANS: CORRELATION OF EYE AND HAIR PIGMENTATION—DETAILS  
BOTH SEXES

EYES	HAIR:			
	Lights	Medium	Darks	
	<i>Per cent</i> (round numbers)			
PURE LIGHTS:				
Blues: Light	53.	43.	2.5	(Reds need not be considered in this connection.)
Medium	35.	48.	14.	
Deep	25.	50.	20.	
Other Lights:				
Greenish & Greenish-Blue	31.	50.	15.5	
Grey & Greyish-Blue	34.	52.5	13.5	
MIXED:	19.5	50.5	25.5	
PURE BROWNS:				
Light	22.5	50.	27.5	
Medium	9.5	50.	38.	
Dark	4.	22.5	73.5	

The above figures show conditions very clearly. The lighter the blue eye the greater the proportion of light hair, and the smaller that of medium and especially dark hair; the deeper the blue, the *less* light, the more medium, and especially the more dark hair. It is plain that there is a direct correlation between the depth of the blue in the iris and the amount of pigment in the hair. This corroborates the view that the pigment in the blue eye is not different from that in the brown eye, but is merely less in quantity and differently deposited. The greenish and greyish eyes in relation to hair are much like the medium blue, though showing somewhat more medium hair—possibly they hide some mixtures. The brown-eyed show the same type of correlation as the blues—the darker the eye the less light and even medium and the more dark the hair. Those with dark brown eyes have no blonds proper, but a few instances of light brown not blond hair, and less than one-fourth of medium, but in nearly three-fourths the hair is dark to black.

The above shows that in general the more pigment there is in the eye, the more there is also in the hair. There are individual exceptions where the hair is lighter than the eyes, but they are not numerous.

ANOMALIES OF EYE PIGMENTATION.—Eye pigmentation shows occasionally interesting anomalies. They are limited to the “mixed” eyes, and seem to be more frequent in females. Also most of them came



from the southern states, which however may be an accident. Those observed were as follows:

Age	Locality	Hair	Eyes
<i>Males:</i>			
51	Va.	dark brown	Mixed; <i>right</i> shows more brown than <i>left</i> .
43	Va.	medium brown	<i>Right</i> greenish; <i>left</i> fine medium blue.
43	Va.	near black	<i>Right</i> grey, traces brown; <i>left</i> , medium brown traces of grey.
23	Md.	medium brown	<i>Right</i> medium blue; <i>left</i> medium blue, traces brown.
<i>Females:</i>			
18	Va.	dark brown	Mixed; <i>right</i> shows very perceptibly more brown than <i>left</i> .
18	Mixed	dark brown	Light blue, slight tinge of brown in <i>left</i> ; more in <i>right</i> .
25	Va.	light brown	<i>Right</i> grey; <i>left</i> lighter than <i>right</i> .
30	Mixed	medium brown	Grey; <i>right</i> traces of brown, <i>left</i> pure.
32	Mixed	medium brown	<i>Right</i> dark brown; <i>left</i> greenish-brown.
34	Pa.	dark brown	<i>Right</i> pure greyish-blue; <i>left</i> same, but with a speck of brown.
45	Va.	golden brown	<i>Right</i> pure deep blue; <i>left</i> same with brown patch.
<i>Triangular Wedges or Segments:</i> <sup>13</sup>			
<i>Females:</i>			
24	Va.	medium brown	<i>Right</i> pure medium blue; <i>left</i> same but with large segment of yellow brown.
24	N. C.	medium brown	Light greenish; in <i>left</i> a nice wedge or segment of medium brown. <sup>14</sup>
30	Va.	medium brown	Medium grey; <i>right</i> shows a clear-cut wedge of medium brown.

No case was observed where one eye would be brown and the other light, though one was learned of.

The most interesting of the anomalies are the wedges or segments of brown in one of the otherwise pure and uniform light eyes. They remind one distantly of the eyes of lizards. The phenomenon is of course a sign of mixture, and probably also of a peculiar histological condition in the given iris.

<sup>13</sup> Beginning at a point on the inner and diverging towards the outer border of the iris.

<sup>14</sup> Father has brown, mother light eyes.

## VIII. BLONDS AND BRUNETS

The terms "blond" and "brunet" are general terms which have as yet no scientifically fixed meaning. As a result when two persons and even two scientists speak of blonds and brunets their meaning may differ.

"Pure blonds" may be defined as those persons who have flaxen, blond, golden, yellow or light brown (near blond) hair, with pure (unmixed) light eyes. More ordinarily, or loosely, all those persons are regarded as "blonds" who have light hair of one or another of the above varieties, with light eyes, whether the latter are pure or would on close examination show traces of brown. And in a still more general way there may be classified as "fair" all those who have hair lighter than medium (including all reds except those of the darkest shades), with light eyes, whether the eyes are pure or would show a mixture on closer scrutiny.

As to "true brunets," that class naturally comprises those with dark to black hair and medium to dark brown eyes. "Apparent brunets" would be all those with dark to black hair regardless of the color of the eyes.

Those who do not enter into any one of the above classes are necessarily the "intermediates."

If we arrange our records on this rational basis, we obtain the following interesting showing:

OLD AMERICANS: BLONDS AND BRUNETS

	Pure Blonds	Ordinary Blonds <sup>15</sup>	"Fair" <sup>16</sup>	True Brunets	Apparent Brunets <sup>17</sup>	Intermediates
	<i>Per cent (in round figures):</i>					
Males (1009)	3.	5.	21.	6.5	26.	53.
Females (914)	3.5	6.5	24.	11.	31.	46.

The above table shows clearly that over one-half of the Old American males and nearly one-half of the females are neither blonds nor brunets, but intermediates. True and even ordinary blonds are scarce, while true brunets are but little more frequent. Using the most general classification we see that approximately but one-fifth of the males and one-fourth of the females may be classed as "fair"; and a little over one-

<sup>15</sup> Includes of course the "pure blonds."

<sup>16</sup> Includes the pure and ordinary blonds.

<sup>17</sup> Includes true brunets.

fourth of the males with a little over three-tenths of the females as "dark" or apparent brunets. The nature of these results is a good expression of ancestral light and darker types, with the latter probably slightly in predominance.

The females, even better than in their separate determinations on the eyes and hair, show plainly somewhat more blonds and "fairs" and again more darks, with less intermediates; thus preserving better than the males the ancestral conditions.

REGIONAL DISTRIBUTION. The regional distribution of the blonds and brunets is shown in the next table:

OLD AMERICANS: BLONDS AND BRUNETS ACCORDING TO REGION  
BOTH SEXES

	Pure Blonds	Ordinary <sup>18</sup> Blonds	"Fair" <sup>19</sup>	True Brunets	Apparent <sup>20</sup> Brunets	Intermediates
	<i>Per cent in round figures</i>					
New England (106)	(13) 12.	(18) 17.	(32) 30.	(4) 4.	(22) 21.	(52) 49.
Eastern States & Mixed-State An- cestry (788)	(29) 4.	(49) 6.	(171) 22.	(83) 10.5	(256) 32.	(361) 46.
South (903)	(19) 2.	(38) 4.	(211) 23.	(77) 8.5	(250) 28.	(442) 49.
Appalachians (126)	(3) 2.5	(6) 5.	(16) 13.	(1) 1.	(19) 15.	(91) 72.

It is seen that conditions appear with especial clearness in this form. New England stands well above the other groups in the proportion of blonds, and is also below all except the Appalachian group in the proportion of darks; but it has as many intermediates as the south and even a few percent more than the east and mixed states.

The south shows less than all the groups, of true blonds, but the "fairs" in general are fully as common as in the eastern states, while brunets both true and apparent are even more numerous in the Americans of eastern and mixed state ancestry than in those of the south.

<sup>18</sup> Includes pure blonds.

<sup>19</sup> Includes pure and ordinary blonds.

<sup>20</sup> Includes true brunets.



The Appalachian group is, as has already been shown, quite exceptional; showing but few blonds and even "fairs," but few brunets, and a very large proportion of intermediates.

The relative darkness of the Old Americans of the eastern states and of mixed-state ancestry is not easy to explain, but they have doubtless more Dutch and German and also Irish ancestry, which may account for the showing.

#### IX. COMPARATIVE

The interest of the results of the observations on pigmentation that form the subject of this paper would be much enhanced could we contrast them with observations on Americans at large and on related peoples. An ideal condition would be if we could also compare them with similar data on the early representatives in America of the families involved, as the present data may perhaps eventually be compared with those on the Americans of the future; but we have no old records of this nature.

The ancestors of the Old Americans, as apparent from the information given the examiner, were very largely, probably more than four-fifths, immigrants from the British Isles. They were English, Welsh, Scotch, Scotch-Irish, with a scattering of Dutch, French (Huguenots), Irish and German. In the absence of old American records on pigmentation it would in the second line be most desirable therefore to have such data from the XVII to XIX centuries from Great Britain, but these are also wanting. All that is available are data on the English speaking people from this and the latter part of the last century, and even these we can use only to a limited extent, the observations having been made and recorded in a different manner. As to data from Holland, Germany or other countries, they could hardly be of help in this connection.

As to data on Americans in general, there are only the very imperfect records of the Civil War, and those equally imperfect obtained during the demobilization after the end of the World War. In neither case were the observations made by scientific or properly trained men. Baxter (Statistics etc. I, 60) says of those in the Civil War: "The instructions given to surgeons of boards of enrollment were framed with a view to the speediest achievement of the object of the draft, and not to the acquisition of anthropological facts. Thence arose defects in the data, from a scientific point of view, which have often been regretted during the preparation of this work."<sup>21</sup> The "Army

<sup>21</sup> For originals see Gould (B. A.)—*The Military & Anthropological Statistics of the War of the Rebellion*. 8°, N. Y., 1865; Baxter (J. H.)—*Statistics, Medical &*

Anthropology" volume of the World War<sup>22</sup> charitably says nothing about the *actual* method of securing the data, though it would have been better to make a straightforward statement. It may suffice to say that the actual examinations and recording, though under the general supervision of good men, had to be made in this case after a brief and insufficient instruction and often under stress and hurry, by numbers of unselected men from the ranks assigned for the "work" by the officers of the camps; men who had no heart in the work, who had never done anything similar, were unacquainted with the metric system, had inaccurate instruments as well as classification, and were often seen by the writer, who specially visited some of the camps to satisfy himself as to the nature of the examinations, to be grossly careless. Moreover the World War records on the pigmentation of the American-born were made wholly worthless by an incomprehensible inclusion into these data of those on the "colored." It would be useless to try to contrast such data with those that are the subject of this paper.

As to England, the foremost students of pigmentation in the British Isles so far were Beddoe,<sup>23</sup> Gray and Tocher,<sup>24</sup> Fleure and James<sup>25</sup> and Parsons.<sup>26</sup> From their data it appears that the pigmentation of the hair and eyes—the skin has not been considered—differs very materially in the different districts and portions of the isles, due to ancestral differences, to an imperfect fusion of the heterogeneous elements of which the population is composed and to local survivals or domination of certain types. The classification of the color of the hair used by these observers agrees fairly well with ours and we shall be enabled to make some general comparisons; but with the English data on eye-color comparison will be very difficult.

Anthropological, of the Provost Marshal-General's Bureau, 4°, 1875, I, 60. See also Statistical Report of Sickness & Mortality in U. S. Army from 1839 to 1855. 4°, Wash., 1856; and Military Statistics of United States of America, 4°, Berlin, 1863.

<sup>22</sup> Davenport (Charles B.) with A. G. Love—Army Anthropology, 8°, Vol. XV of Statistics Med. Dept., U. S. Army, Wash., 1921.

<sup>23</sup> Beddoe (John)—Races of Britain, 8°, London, 1885.

<sup>24</sup> Gray (John) & Tocher (J. F.)—The physical characteristics of adults & school children in east Aberdeenshire. *J. Anthropol. Inst.*, 1900, XXX, 104-124; also *Trans. Buchan. Field Club*, 1897.

<sup>25</sup> Fleure (H. J.) & James (T. C.)—Geographical Distribution of Anthropological Types in Wales. *J. Anthropol. Inst.*, 1916, XLVI, 35-153.

<sup>26</sup> Parsons (F. G.)—The Color-Index of the Brit. Isles. *J. Anthropol. Inst.*, 1920, L, 159-162.

The English records were recently partly summarized by Parsons.<sup>27</sup> Following Beddoe, the English observers classify the hair into fair (corresponding to our "light"), red, brown (our "medium"), dark and black; while the eyes are classed as light, dark and intermediate. The relation of this classification to ours will appear best in the following form:

CLASSIFICATION OF HAIR AND EYE COLOR IN ENGLAND AND IN OLD AMERICANS

	ENGLISH	OLD AMERICANS
<i>Hair:</i>	Fair	Light { blond golden & yellow light brown (near blond)
	Brown	Light brown (not blond) Medium
	Dark brown	Dark
	Black	Black
	Red	Red
<i>Eyes</i>	Light	Pure Lights { Blues { light medium deep Greenish Greyish
	Intermediate or Neutral	Mixed
	Dark	Pure Browns { light medium dark

In the case of the hair the two methods agree fairly closely, except as to our "light brown (not blond)" which class is omitted from the English records. In the case of the eyes, however, there is much less agreement. Some of the light browns had probably been recorded by the English among the "intermediates"; many light eyes with a brown ring about the pupil or some brown spots, which in our records are all marked as mixed, were doubtless counted by the English among the "lights"; and the slate blues with some of the darker mixed they very likely included with the darks.

An additional difficulty for comparing our results arises from the way in which the English records are published. Neither Beddoe nor his

<sup>27</sup> O. C.



followers have given us the general averages for the whole of England and Scotland. They report their observations by counties, cities and other localities, which is of but little use for our purpose. We have no means of finding out from just what parts of England and Scotland the ancestors of the Old American families were derived, and the best we can do in trying to find what changes, if any, there are now between the people of Great Britain and the Old Americans, is to compare the combined records of the latter with similarly combined records on Great Britain or at least England and Scotland. In order to make some such comparison possible it was necessary to count up Beddoe's detailed data as given by Parsons.<sup>28</sup> The results, contrasted with ours, are as follows:

COLOR OF HAIR IN ENGLAND AND SCOTLAND, AND IN THE OLD AMERICANS  
MALES

Hair	Old Americans	Present England & Scotland
	(1000) <i>Per cent</i>	(14,557) <i>Per cent</i>
Lights proper	6.4	16.7
Light brown (not blond)	16.4	
Medium	50.4	38.3
Dark	23.7	34.8
Black	0.4	5.8
Red	2.7	4.4

These figures are rather striking. Even if we allow for some error in assigning the different colors to their proper classes on each side, enough seems to remain to show that the English present a greater heterogeneity in hair pigmentation. The Old Americans have apparently less real blonds and certainly less darks and blacks as well as reds, with more blends or intermediates. While the total amount of pigmentation is not greatly different in the two units, in the Americans it shows fewer extremes, which is just about what could be expected from their great intermixture. To make the two series still more comparable, the proportion of the "light brown (not blond)" hair among the Americans could probably be safely distributed one-half to the "fair" and one-half to the "medium" series, in which case we obtain the following relations:

<sup>28</sup> *J. Anthropol. Inst.*, 1920, 168-9.

## COLOR OF HAIR IN ENGLAND AND SCOTLAND, AND IN THE OLD AMERICANS

## MALES

Hair	Old Americans	Present England & Scotland
	<i>Per cent</i>	<i>Per cent</i>
Fair	14.6	16.7
Medium	58.6	38.3
Dark	23.7	34.8
Black	0.4	5.8
Red	2.7	4.4

We still have for the Old Americans less blonds and reds, less darks, and decidedly more intermediates.

So much for the men. With the females the conditions are similar:

## COLOR OF HAIR IN ENGLAND AND SCOTLAND, AND IN THE OLD AMERICANS

## FEMALES

Hair	Old Americans	Present England & Scotland
	(900)	(11,172)
	<i>Per cent</i>	<i>Per cent</i>
Fair	12.4	13.1
Light brown (not blond)	10.	
Medium	40.3	38.1
Dark	29.4	39.3
Black	0.6	4.8
Red	4.7	4.7

On the whole the British and the Old American females seem to agree better as to hair color than the males, but like the males show a considerably larger proportion of dark hair than occurs in the Americans.

The records on eyes show the following conditions in the two groups under consideration:

## COLOR OF EYES IN OLD AMERICANS CONTRASTED WITH THAT IN GREAT BRITAIN

## MALE

## FEMALE

	Light	Intermediate or Mixed	Dark (Medium & Dark Brown)	Light	Intermediate or Mixed	Dark (Medium & Dark Brown)
Old Americans	<i>Per cent</i> 31.	57.	12.	24.2	58.	18.
England, Wales & Scotland	88. 66.		34.	53.3	15.2	31.5
				82.2		
				68.5		

In view of the manner in which the English records were made there are no means of separating the pure lights from the mixed lights as in our series; but the English "dark" eyes ought to correspond more closely to our medium plus dark browns class. The results show, however, a very much larger proportion of "dark" eyes in Great Britain than among the Old Americans. The more common occurrence among the English of dark to black hair would lead us to expect also a moderately greater frequency in the same series of dark eyes; but the excess of dark eyes is so great as to justify the suspicion that the Beddoe "dark" eye series includes various eyes besides the medium and dark brown which makes it unfit for comparison with our data. After an earnest effort to utilize the English eye records we are thus left quite helpless. The probability is that the average present eye pigmentation in Great Britain differs only slightly from that of the Old Americans.

Since Beddoe the English observers have another and convenient though somewhat artificial method of expressing their records on pigmentation, and that is through their so-called "index of nigrescence." This index, as modified by Parsons,<sup>29</sup> is obtained by adding the percentage of the dark brown and black hair to that of the dark, plus one-half of the intermediary or neutral eyes, and dividing the results by two. Unfortunately as already seen, their classes of eye colors are very different from ours, which precludes any direct comparison.

However imperfect our efforts at comparison with the English may have been, they leave two impressions of value. The first is that both the Old Americans and the English, if classed by the mean value of their pigmentation, fall not into the "fair" but into the intermediary or medium-pigmented group, which tapers on one side to the fair and on the other to the brunet. The second fact is that the English show in their midst less intermixture with consequent blends than do the Old Americans.

The lack of marked difference in pigmentation between the Old Americans and the English does not denote, however, that no changes in this respect have taken place in the Americans since the arrival from Europe of their ancestors. It is quite possible that a gradual progressive darkening has proceeded in both groups. There are observers in both countries who incline to that opinion. Pigmentation is essentially an environmental and changeable condition, however slow the changes may be. Neither England, nor certainly the United States, are in the sphere of the nordic countries where blondness was produced and

<sup>29</sup> *J. Anthropol. Inst.*, 1920, 162.



where it is being sustained. And the composition, climate, habits and food of the people in the United States and Great Britain are so similar that the two people might well be assumed, on general considerations, to show a parallel line of changes in a physiological characteristic such as pigmentation.

The whole subject in both countries needs a thorough scientific re-study on a large scale. It would be a fallacy to believe that observations, however superficial they might be, if only made on a large enough number of subjects, would ever show true conditions; such data can at best only approximate, but may also more or less mask if not pervert, the real facts.

#### X. GREY HAIR

In 250 of the examined men and 200 women, special attention was given to the subject of the greying of hair.

The ordinary notions as to greyness are very empirical and superficial, yet there is much of interest to be learned in this connection. The condition, however, is not easy to study. Few elderly people remember correctly when they began to notice grey hairs or how the process progressed; and even for the scientific observer it is not easy to estimate correctly the many grades of the change.

The best way to proceed in the study of greying was soon seen to be the statistical, and the only effective way of recording was found to be by estimates in percentages of the quantity of the grey hair in relation to all the hair on the head. Accordingly the incidence of grey hair was recorded as: None; very few to few; some to  $1/3$ ; approximately  $1/2$  ( $2/5$ - $4/7$ );  $2/3$  to nearly all; and all. The observations gave the following results:

OLD AMERICANS: GREYNESS

	None	Very Few to Few	Some to about $\frac{1}{3}$	Approx- imately $\frac{1}{2}$	$\frac{2}{3}$ to Near All	All Grey (More or less completely)
(250)	(107)	(47)	(33)	(11)	(41)	(11)
	<i>Per cent:</i>					
Males	42.8	18.8	13.2	4.4	16.4	4.4
(Mean age 42.6 y.)	(22-48 y.)	(24-55 y.)	(25-57 y.)	(37-58 y.)	(39-65 y.)	(48-65 y.)
(200)	(104)	(30)	(29)	(9)	(21)	(7)
	<i>Per cent:</i>					
Females	52.	15.	14.5	4.5	10.5	3.5
(Mean age 41.8 y.)	(24-48 y.)	(24-55 y.)	(30-58 y.)	(37-59 y.)	(39-60 y.)	(51-60 y.)

These data only show that greyness long before old age in both sexes is frequent; that there evidently is throughout adult life a slightly less tendency to it among females than among males; that for some perhaps not strictly physiological reason there is an undue frequency of the two-thirds to all greys in both sexes, and that both in appearance and progress of greying there is great individual variation.

Some further light on the condition may be had by arranging the data by age:

OLD AMERICANS: GREYNESS OF HAIR IN RELATION TO AGE

MALES							FEMALES						
Age & No. of Subjects	None	Very Few to Few	Some to $\frac{1}{2}$	About $\frac{1}{2}$ ( $\frac{2}{3}$ - $\frac{4}{7}$ )	$\frac{2}{3}$ to Near All	All	Age No. of Subjects	None	Very Few to Few	Some to $\frac{1}{2}$	About $\frac{1}{2}$ ( $\frac{2}{3}$ - $\frac{4}{7}$ )	$\frac{2}{3}$ to Near All	All
24-30 (100)	74	18	6	1	1		24-30 (80)	8.5	11.2	3.8			
31-40 (63)	44.4	27.	19.0	3.2	6.4		31-40 (63)	47.6	25.4	19.0	4.8	3.2	
41-50 (44)	9.1	20.4	27.3	11.4	27.3	4.5	41-50 (29)	13.8	17.2	37.9	10.3	13.8	6.9
51-60 (35)	2.9	8.6	8.5	8.6	51.4	20.0	51-60 (28)	7.1		10.7	10.7	53.9	17.6
61-65 (8)					75.0	25.0							
Totals (259)	42.8	18.8	13.2	4.4	16.4	4.4	(200)	52	15.0	14.5	4.5	10.5	3.5

Thirty percent approximately of the Old American men and 11 percent of the women have a few to over one-third of grey hair before they pass their thirtieth year. Between 31 and 40 less than half of the males and a little less than three-fifths of the females are without grey hair, and the proportion of such persons is reduced to a little over 10 per cent during the next decennium. Over 35 percent of the males between 41 and 50, and 16 percent of the females between these ages show already greyness that involves from two-thirds of all the hair; and for those between 51 and 60 this proportion rises to very nearly three-fourths of the males and seven-tenths of the females.

The females show throughout slightly less tendency to greying than the males. Undue predominance of the two-thirds-to-nearly-all grey is shown again.

Some day, when we shall have equally detailed data on greying in other peoples, the above figures ought to make interesting comparison and lead to some definite deductions of anthropological nature.

#### TEMPORARY GREYNESS

The phenomenon of sudden or very rapid greying, generally under the stress of great fear, anxiety or other deeply disturbing nervous effect, is well known, though more so popularly than to science; but the sequences of such a change are only seldom mentioned. A striking case came to the writer's attention in the course of the studies here reported. It concerns General Greely, the arctic explorer. General Greely was born in 1844. His hair, when he reached the adult life, was "chatain" or rather dark brown, and it remained so, with probably the appearance of a few grey hairs, until 1884, or towards the end of his exceedingly difficult trip of arctic exploration. Then, within the period of some months, under the anxieties and privations of his position, his hair turned completely white. But upon a return to civilization the whiteness began gradually to disappear, until the hair returned to nearly its former condition, after which greying progressed naturally. The following brief personal statement will make a clear record of the case:

COSMOS CLUB  
Washington, D. C.

March 8, 1922.

Dear Dr. Hrdlička:

Referring to our conversation a few days since, I confirm my statement that when rescued at Cape Sabine in 1884 my hair was entirely white, due probably to the *continuous* condition of semi-starvation from which I suffered for over 9 months. Within a year my hair darkened very considerably, though it never returned *entirely* to its original chataine coloring.

Yours,  
A. W. GREELY  
Major General.

#### XI. LOSS OF HAIR

In modern civilized man the hair of the head does not merely tend to grow grey earlier than in more primitive people, but generally also it is more or less shed as aging advances, showing a reduced vitality. It would be wrong to attribute either of these phenomena to any particular habits of civilized man or to pathological conditions, though both of these may play a part at times; the real causes are already hereditary and thereby of a phylogenetic nature. The hair tends towards an earlier senility and loss because it has become of less organic



use to man living under modern conditions, than it had been in the past, and nature does not tolerate for long what has become useless or weakened. Both early greying and physiological loss of hair are a part of the trend of present evolution in civilized humanity.

Unlike greyness, however, normal loss of hair is largely linked with the male sex. Women lose hair too, and that probably at an increasing rate, but not in the proportion in which the process goes on in the males.

A special inquiry into this subject among 250 male and 200 female Old Americans, taken without any selection, showed the interesting results given below. As all the females were examined with their hair undone and freely hanging down to permit the unimpeded taking of head measurements, there can be no question of the observer having been misled.

## OLD AMERICANS: LOSS OF HAIR

MALES (250)

FEMALES (200)

Loss	Percent of Cases	Ages Average-Extremes	Percent of Cases	Ages Average-Extremes
No plainly appreciable	45.2	(24-60)	85	(23-60)
Slight	13.6	37 (24-60)	11	44 (29-55)
Some to $\frac{1}{3}$	22.4	39 (24-57)	3	
Approximately $\frac{1}{2}$	7.2	46 (29-65)	1	
$\frac{2}{3}$ to near all	11.6	49 (35-64)		

## OLD AMERICANS: LOSS OF HAIR IN RELATION TO AGE

MALES (250)

FEMALES (200)

## LOSS OF HAIR:

Age No. of Subjects	None Perceptible	Slight	Some to $\frac{1}{3}$	Approx. $\frac{1}{2}$ ( $\frac{2}{3}$ -4/7)	$\frac{2}{3}$ to Near All	Age No. of Subjects	None Perceptible	Slight	Some to $\frac{1}{3}$	Approx. $\frac{1}{2}$ ( $\frac{2}{3}$ -4/7)	$\frac{2}{3}$ to Near All
<i>Per cent</i>											
21-30 (100)	68.	11.	17.	3.	1.	21-30 (80)	98.8		1.2		
31-40 (63)	46.	17.5	22.2	4.8	9.5	31-40 (63)	95.5	1.5	1.5	1.5	
41-50 (44)	29.6	18.2	34.1	6.8	11.3	41-50 (29)	85.	5.	10.		
51-60 (35)	8.6	8.6	25.7	20.	37.1	51-60 (28)	84.3	5.	7.1	3.6	
61-65 (8)		12.5	12.5	25.	50.						

The foregoing figures show that loss of hair in the Old Americans presents wide individual and even wider sexual variation. There were seen men and women of sixty in whom there was as yet no appreciable loss; but on the other hand plain thinning was seen not merely in some of the youngest male adults of the series but even in some subadults down to 18 years of age. The progress of the condition, once it has set in, is generally continuous though not always regular.

The great difference in the frequency and average grade of the loss of hair between the males and females is difficult to explain. Possibly the weight of the female hair acts as a tonic. The differences between the head covering in the males and females may also have an effect. But in all probability a more or less male-linked predisposition to the condition is already inherited.

In this case, again, we have no similar data on other peoples that could be used for comparison; but as interest in these secondary manifestations will grow such data will doubtless be forthcoming.

## XII. CONCLUSIONS

The above data on the eyes and hair permit the formulation of the following conclusions regarding pigmentation, and the other conditions here studied, in the Old Americans:

SKIN. 1. Two-thirds of the old stock males and three-fourths of the females show skin that may be classed as medium.

2. In only 5 per thousand in males, but in 52 per thousand in the females, is the skin plainly lighter than the medium. All of these cases are associated with pure light eyes and light or red hair.

3. In a little over one-fourth of the males and in one-sixth of the females the skin is perceptibly darker than medium. Such skin is generally associated with brown eyes and medium to dark hair.

HAIR. 1. Only 1 among 16 males and 1 among 14.5 females has real blond hair.

2. One-half of the males and over four-tenths of the females show medium (or "medium brown") hair.

3. In one-fourth of the males and three-tenths of the females the hair is dark ("dark brown"), to near black.

4. In approximately 1 percent in the males and but a little more in the females the hair is fully black.

5. In 2.6 per hundred of males and 4.9 per hundred in females the hair is red or near red.

6. The females show a slight to moderate excess of true blonds

(especially golden and yellow), but also of darks, blacks and reds, over the males.

7. There are some areas in which hair pigmentation among the Old Americans, due to isolation and more thorough mixtures, differs from that of the group as a whole.

8. Differences between the "Yankees" and the "Southerners" in this respect are only moderate, the former showing somewhat more lights, less darks, few if any true blacks and less reds. But the southerners show almost identical conditions in regard to hair pigmentation as those of the central states and those of mixed-state ancestry.

EYES. 1. Approximately one-third of the eyes of the males and one-fourth of the eyes of the females of the Old Americans are pure lights.

2. One-sixth of the males and one-fifth of the females show eyes the iris of which is pure brown (light, medium or dark).

3. Over one-half of the males as well as females have eyes that show plain traces of brown in light (mixed).

4. There are on the whole more light and less dark eyes than there is of light and dark hair.

5. Regional differences are less marked than with the hair, except in isolated localities.

6. There is a considerable but not a complete correlation between the pigmentation of the eyes and that of the hair. Light eyes may in some instances be associated with dark (though not black) hair; but medium to dark eyes are as a rule accompanied by medium, dark or black hair.

BLONDS AND BRUNETS. 1. The classification of the Old Americans on the basis of both the color of the eyes and hair brings a number of the conditions relating to pigmentation out with special clearness.

2. Over one-half of the males and nearly one-half of the females are "intermediates."

3. Blondes are scarce, as are also true brunets, but the latter are plainly more frequent, especially in the females.

4. The females show slightly more blondes, more brunettes and less intermediates than the males.

GREY HAIR. 1. In general, greyness manifests itself early in the Old Americans.

2. In the males greyness proceeds appreciably faster than in the females.

3. There is wide individual variation.



LOSS OF HAIR. 1. There are great sexual differences in this respect. The males lose hair sooner, more rapidly and much more extensively than the females.

2. In males loss begins at times even before adult stage is reached; and after 55 there are very few men in whom some degree of loss at least has not taken place.

3. Wide individual differences exist also in this respect.

COMPARISONS. Suitable data for comparison are scarce. From what is available it appears that the pigmentation of both hair and eyes in the Old Americans is much like that of the present population of Great Britain, though the latter appears to show some excess of both dark eyes and dark hair.

As to changes with time, it seems probable that in both Great Britain and the United States there is taking place a slow progress towards a darker pigmentation of both eyes and hair, though the fact needs definite confirmation.

# RACIAL DIFFERENCES IN PALM AND SOLE CONFIGURATION

PALM AND SOLE PRINTS OF JAPANESE AND CHINESE

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## INTRODUCTION

The present paper is the third of a series projected several years ago with the idea of ascertaining what racial differences might be found in the friction-skin configuration of the palms and soles, and whether, by taking the averages of large enough numbers, these differences might prove sufficiently constant to serve as definite racial criteria.

Although it was apparent from the start that there were in these parts no racial criteria so positive, and so constant, that they could be reliable in single cases, it was thought that there might be certain peculiarities of greater percentile occurrence in one race than in another, and that these peculiarities might be of real ethnological importance when a fairly large number of representatives, say 100, could be taken.

In the paper of 1904,<sup>1</sup> the first of the series, studies were made of the palm and sole prints of Maya Indians from Yucatan, collected for me by Dr. A. M. Tozzer, and with these were compared the prints of American negroes and of European Americans (female college students); and, although the number of individuals was a small one, certain positive results appeared, encouraging further investigations along this line, and showing quite definitely that a rather small number of individuals (certainly fewer than a hundred) could be relied upon to furnish fairly reliable results.

The second paper of this series appeared in 1913,<sup>2</sup> the description of the palm and sole configuration of native Liberian negroes, from a set of prints collected for me by Frederick Starr. This corroborated the results of the first paper regarding certain definite characteristics of negroes of American birth, and showed the essential identity of race between these Liberian natives, and their migrant relatives in the New World.

The occasion of a visit to Japan and China, undertaken last year (1920) enabled me to make fairly large collections of prints of these two Oriental peoples, and as, in the meanwhile, we have become possessed of a detailed paper on the Japanese palms and soles, written from exactly the same standpoint (Hasebe, 1918),<sup>3</sup> I am now enabled to add his results to my own, and by so doing to collect data from a larger number of individuals than from any race excepting our own. By this means I can now subject the entire method to a definite test, and state with some definiteness just how far it is reliable as a racial criterion, and also, what is of equal importance, the point beyond which we cannot go.

My Japanese collections were made in Kyoto by students of the Doshisha University and by those of the Woman's College associated with it.

<sup>1</sup> *Amer. Anthropologist*, Vol. VI, 1904, pp. 244-293.

<sup>2</sup> *Amer. Anthropologist*, Vol. XV, 1913, pp. 189-207.

<sup>3</sup> Hasebe, K. *Ueber das Hautleisten system der Vola und Planta der Japaner und Aino. Arbeiten aus dem anat. Institut der Kaiserl.-Japanischen Universität zu Sendai.* 18 April, 1918.



The prints of the men students were made by Mr. Kenichiro Sakurai, a theological student, and his two associates, Messrs. Ei Kobayashi and Takeo Hishimoto, who learned the simple procedure directly from me. I wish to state in this place that Mr. Sakurai, finding it somewhat difficult to get good prints of the upper (distal) margin of the palms of the Japanese, perhaps owing to some slight difference in shape or proportions of their hands, devised a method of printing this part by itself, and appending it to the usual print, a method which will undoubtedly prove of value in other cases. He selected a round stick of bamboo, of a diameter of an inch or a little less, inked the palm directly especially about the base of the fingers, wound a piece of paper about the stick, and then requested the subject to grasp it, placing it especially at the place to be printed. The results were extremely satisfactory, and as such a supplementary patch accompanied each print taken in the old way, I got a very complete record of each hand. Indeed, so much of the essential parts of the entire hand was shown by this patch that for many purposes the patch was enough, and furnished a series of pictures which could be easily reproduced as line drawings, and be readily available for published illustrations. Whether there is really any essential difference in Japanese hand shapes that would render such a proceeding necessary I do not know and am inclined to doubt, but in any case a beautiful print of this essential region may be easily made by this means, and for this device Mr. Sakurai should be given sole credit.

The prints of the Japanese females were taken through the direct supervision of the Dean of Women at the same institution, Dean Rokuro Nakaseko, who undertook the matter with scientific zeal, and whose results were of the greatest excellence. Here my own participation in the matter consisted in holding an impromptu class in the hall of the school, in the presence of Dr. Nakaseko, several girl students, who served as subjects, and an interested newspaper reporter, a class of men even more ubiquitous in Japan than in the United States. In thanking these students who, under my instruction, began the work of collecting the girls' prints, I wish to mention the names of Misses Asakawa, Hata, and Saito. In case this paper should meet the eyes of any who either furnished themselves as subjects or who assisted in taking the prints I wish to express my sincere gratitude, and may state definitely that, but for their aid, this paper would never have been written.

My collections in China, as in Japan, were obtained through the agency of College students, those of the men from Shanghai College,

and those of women through the girl students at Gin-Ling College in Nanking. Naturally in the case of women, the absurd practice of foot-binding, which, in spite of modern ideas of reform, is still shockingly prevalent among the higher classes, renders all investigation of the sole impossible where it occurs; girls of college interests, however, have in the main natural feet, and they can always find plenty of women of the servant class, as well as their own emancipated associates, who have not been subjected to such artificial deformation. It is, however, true that among the Chinese of both sexes the native Chinese shoe, with its pointed toe, and the ignoring of the fact that feet are normally rights and lefts, causes an unintentional deformation affecting the toes, so that everywhere one meets with ugly misshapings fully as bad as those found in our ultra-fashionable set, with their high heels and pointed toes.

As in Japan, my Chinese collections were started by first interesting college students, and showing them the method of printing, after which they readily continued the collections. At Shanghai the collection was made by myself among the boys in my classes, and by the boys themselves, among whom I wish to especially remember Messrs. Ling Hwa-Chen, Li Ging-Biao, and Fu Shan-Ling. At Gin-Ling, after some preliminary teaching of printing methods to a class of about ten, the main collections were made by one of them, Miss Yang Ging-Hsioh, who did her work mainly at her home during the summer vacation, and embraced women from various walks in life and of all ages. To all of these I wish to express my sincerest thanks.

Touching upon the subject of foot deformation, intentional or accidental, as met with among the Chinese, I am led to say that *in Japan*, on the contrary, *are found the most perfect feet in the world*. The clog (geta), the well-nigh universal form of foot gear, leaves the foot wholly unconfined, while it saves it from the constant knocks and bruises to which habitually barefooted peoples are subject. Aside from this the very essential of the clog is the constant grasping of the thong between the first and second toes, preserving unmodified the natural space between these toes, and encouraging their semi-prehensile action. These influences, together with the popular regard for feet as about the same thing as hands, and the consequent lack of all false modesty regarding them, *render Japan a paradise for the student of human feet*. The result of this perfectly natural treatment here, as contrasted with intentional and unintentional deformation in China, sufficiently accounts

for the great difference in sentiment concerning these important members in the two countries.

## I. PALMS

### 1 THE FOUR MAIN LINES

#### 1a THE FOUR MAIN LINES OF THE JAPANESE

In 1918 Dr. Kotondo Hasebe, of the University of Sendai, Japan, published an extensive paper on the friction-skin configuration of the palms and soles of the Japanese and the Aino.<sup>3</sup> It was the first paper to deal with these features of the Japanese, and included studies of a large number of individuals. As my own Japanese collections are also fairly large the summarizing of the results of both render available nearly one thousand separate palms and the same number of soles, larger than the like details of any race except the somewhat mixed "Americans," and quite enough to serve as a basis for a careful examination of the method viewed as a racial criterion. The number of Japanese studied by Hasebe and myself, are as follows:

	Male Individuals	Female Individuals	Individuals, Both Sexes	Separate Male Palms	Separate Female Palms	Separate Palms Both Sexes
HASEBE (1918)	215	61	276	430	122	552
WILDER (1921)	83	112	195	166	224	390
Both	298	173	471	596	346	942

The following lists, Tables I and II, give the Main Line Formulae, and the Carpal conditions (whether a carpal triradius is present or not) of my two Japanese collections. In my personal collection the Japanese males are given the numbers 1501-1587, and the Japanese females the numbers 1601-1712 inclusive, but here the final digits of each hundred are employed alone. Complete explanation of these Main Line formulae are found in my article, *Palm and Sole Studies*, published in *Biol. Bull.* Feb.-March, 1916, as well as in *Personal Identification* (Wilder and Wentworth; Badger, Boston, 1918). This latter work gives also an explanation of the Sole formulae used here, and furnishes a key to the numbers employed therein.



TABLE I  
Japanese Males, Doshisha University, Kyoto. Coll. Mr. Sakurai, 1920  
Main Line Formulae of 83 Individuals

	Lefts	Rights		Lefts	Rights
1	10.9.6.2.C	9.7.5.5.C	45	7.5.5.1.P	9.7.5.3.C
2	7.5.5.5.C	8.6.5.5.C	46	8.6.5.5.C	9.7.5.5.P
3	7.7.5.2.C	11.10.8.5.C	47	7.5.5.3.C	8.6.5.5.C
4	7.5.5.3.P	8.6.5.5.P	48	10.7.6.3.C	11.9.7.5.C
			49	11.7.7.1.C	11.7.7.5.C
6	10.x.6.3.C	11.9.7.5.C	50	7.5.5.3.C	7.5.5.5.C
7	7 <sup>t</sup> .9.5.3.C	7.5.5.3.C	51	7.5.5.3.C	9.7.5.3.P
8	7.5.5.3.P		52	11.8.7.5.C	11.9.7.5.C
9	7.5.5.3.P		53	7.5.5.3.C	9.7.5.5.C
			54	7.5.5.3.P	8.6.5.3.C
11	11.7.7.5.P	11.9.7.5.P	55	7.5.5.5.C	11.7.7.5.P
12	11.x <sup>t</sup> .7.5.P	11.x.x.5.P	56	8 <sup>t</sup> .6.5.2.C	10.7.6.3.C
13	8.6.5.3.P	9.7.5.3.P	57	7.5.5.5.C	7.5.5.5 <sup>t</sup> .C
14	10.9.6.1.P	11.9.7.3.C	58	9.7.5.5.C	11.9.7.5.P
15	8.6.5.5.C	9.x.5.5.C	59	9.9.5.3.C	10.8.6.5.P
16	7.5.5.1.C	11.9.7.5.C	60	8.6.5.1.P	9.7.5.3.P
17	11.9.7.5 <sup>t</sup> .C	12.10.8.6 <sup>t</sup> .C	61	10.8.6.5.P	11.9.7.5.C
18	11.9.7.4.P	7.5.5.3.P	62	7.5.5.4.C	7.5.5.4.P
19	7.5.5.3.P	7.5.5.3.P	63	6.5.5.1.P	8.6.5.3.P
20	7.5.5.3.P	8.6.5.3.P	64	9.7.5.3.C	9.x.5.5.C
21	9.7.5.4.P	11.9.7.5.P	65	9.x.7.5.P	11.10.8.5.P
22	10.9.6.3.C	11.11.9.5 <sup>t</sup> .C	66	10.7.6.3.C	11.7.7.5.C
23	9.7.5.3.C	11.9.7.5.C	67	10.7.6.3.C	10.8.6.5.C
24	7.5.5.1.C	7.5.5.1.C	68	8.6.5.3.P	9.7.5.3.C
25	11.x.7.5.C	11.8.10.5.C	69	7.5.5.1.P	8.6.5.3.C
26	9.9.5.5.C	10.9.6.5.C	70	7.5.5.1.P	9.7.5.5.C
27	7.5.5.3.C	7.5.5.3.C	71	7.5.5.4.C	7.5.5.5.C
28	6 <sup>t</sup> .5.5.3.C	8.6.5.5.P	72	9.7.5.1.C	9.7.5.3.C
29	9 <sup>t</sup> .7.5.5.C	11 <sup>t</sup> .9.7.5.C	73	9.7.5.1.C	11.9.7.5.C
30	7.5.5.3.C	7.5.5.5.C	74	9.x.5.3.P	11.9.7.5.P
31	7.5.5.3.C	9.7.5.4.P	75	9.8.5.3.C	9.7.5.3.P
32	7.5.5.5.P	8.6.5.5.C	76	10 <sup>t</sup> .9.6.5.P	11.9.7.5.C
33	7.5.5.1.C	7.5.5.1.C	77	7.5.5.1.C	7.5.5.1.C
34	9.7.5.5.C	11.9.7.5.C	78	9 <sup>t</sup> .7.5.3.C	9.8.5.5.C
35	10.8.6.5.C	11.9.7.5.C	79	9.7.7.3.C	11.10.8.3.C
36	11.7.7.5.C	11.10.8.3.C	80	10.7.6.1.C	11.9.7.3.C
37	9.7.5.1.C	11.9.7.5.P	81	10 <sup>t</sup> .8.6.5.C	11.11.9.5.C
38	9.7.5.5.P	11.7.6.5.P	82	9 <sup>t</sup> .9.5.5.C	7 <sup>t</sup> .5.5.5.P
39	7.5.5.4.P	9.7.5.4.P	83	9.7.5.5.C	11.8.7.5.C
40	9.7.5.3.C	11.10.8.5.C	84	9 <sup>t</sup> .x.5.5.C	9 <sup>t</sup> .7.5.5.C
41	11.10.8.5.C	11.9.7.5.C	85	9 <sup>t</sup> .7.5.5.C	11.9.7.5.C
42	7.8 <sup>t</sup> .5.1.C	8.6.5.3.C	86	7.5.5.5.C	8.6.5.5.P
43	11.8.7.3.P	11.10.8.5.P	87	8.6.5.5.C	8 <sup>t</sup> .6.5.5.C
44	11.x.7.5.C	11.9.7.5.C			

TABLE II

Japanese Females, Doshisha University, Kyoto. Coll. Dean Nakaseko and students, 1920

Main Line Formulae of 112 individuals

	Lefts	Rights		Lefts	Rights
1	11.7.7.1.C	10.9.6.3.C	42	10.7.6.3.C	11.x.7.5.C
2	7.5.5.1.C	8.6.5.3.P	43	11.7.7.5.C	11.9.7.5.C
3	8.6.5.2.C	9.7.5.1.C	44	10.8.6.5.C	10.7.6.5.C
4	9.7.5.3.C <sup>h</sup>	10.9.6.3.C <sup>h</sup>	45	7.5.5.5.C	9.7.5.3.C
5	9.x.5.4.C	11.x.7.3.P	46	7.5.5.5.P	11.9.7.5.C
6	7.5.5.1.C <sup>h</sup>	8.6.5.3.C	47	9.x.5.1.C	11.x.7.5.C
7	9.9.5.3.C	11.9.7.3.C	48	7.x.5.5.C	11 <sup>t</sup> .x.7.5.C
8	9.8.5.3.C	9.7.5.3.C	49	9.7.5.3.C	9.7.5.5.C
9	10.7.6.1.C	11.9.7.5.C	50	9.9.5.1.C	11.9.7.5.C
10	7.5.5.3.C	7.5.5.3.C	51	9.8.5.5.P	10.10.8.5.P
11	10.7.6.5.C	11.9.7.5.C	52	7.5.5.5.P	11.7.7.5.P
12	7.7.5.1.C	11.9.7.5.C	53	11.x.7.5.C	11.10.8.5.C
13	7.5.5.1.C	7.5.5.3.C	54	9.x.5.5.C	11.x.7.4.C
14	7.5.5.3.C	8.6.5.5.C	55	7.5.5.3.P	9.7.5.3.C
15	8.6.5.3.C	9.7.5.3.P	56	10.7.6.3.C	8.6.5.5.C
16	11.7.7.1.C	10.7.6.1.P	57	7 <sup>t</sup> .5.5.5.C	8.7.5.5.C
17	8.6.5.3.C <sup>h</sup>	8.6.5.5.C <sup>h</sup>	58	7.5.5.1.C <sup>h</sup>	7.5.5.3.C
18	11.9.7.3.P	11.10.8.5.P	59	7.5.5.3.C	9.7.5.5.C
19	7.5.5.2.C	7.5.5.5.C	60	7.5.5.5.C	7.5.5.5.C
20	7.5.5.3.P	8.6.5.3.P	61	8.6.5.4.C	8.6.5.5.C
21	7.5.5.3.C	10.9.6.5.C	62	9 <sup>t</sup> .x.5.5.C	7.7 <sup>t</sup> .5.5.C
22	9.7.5.4.P	9.7.5.5.P	63	11.7.7.2.C <sup>h</sup>	11.7.7.5.C <sup>h</sup>
23	7.5.5.3.C	7.5.5.1.C	64	7.5.5.3.C	8.6.5.3.C
24	7.5.5.1.C	8.6.5.3.C	65	11.7.7.3.P	11.7.7.5.P
25	7.5.5.1.C	8.6.5.3.C	66	7.5.5.3.C	11.8.7.5.C
26	7.5.5.3.C	8.6.5.3. (?)	67	10 <sup>t</sup> .7.6 <sup>t</sup> .5.C	9 <sup>t</sup> .9.5.5.C
27	7.5.5.2.C	9.7.5.3.C	68	7.5.5.5.C	8.6.5.5.C
28	11.x.7.5.C	11.11.9 <sup>8</sup> .5.C	69	10.8.6.1.P	11.9.7.5.C
29	11.x.7.2.C	11.9.7.5.C	70	7.5.5.5.C	9.7.5.5.C
30	8.6.5.3.C	9.x.5.5.C	71	10.7.6.1.C	8 <sup>8</sup> .6 <sup>7</sup> .5.5.C
31	10.7.6.3.C	9.7.5.5.C	72	8.6.5.1.C	9.7.5.3.P
32	7.5.5.1.C	11.9.7.5.C(?)	73	9.x.5.5.C	10.x.6.5.C
33	9.7.5.3.C	9.7.5.5.C	74	10.7.6.5.C	9.7.5.5.C
34	11.9.7.2.C	11.9.7.3.C <sup>h</sup>	75	7.5.5.1.C	9.7.5.5.C
35	10.x.6.5.C	11.9.7.5.C	76	11.7.7.5.C	11.9.7.5.C
36	9.7.5.3.C	9.7.5.4.P	77	7.5.5.1.P	8.6.5.4.C
37	8.6.5.5.P	7.5.5.1.P	78	6.5.5.2.C	9.7.5.4.C
38	7.5.5.3.C	8.6.5.5.P	79	10.7.6.5.C	7.5.5.5.C
39	8.6.5.5.C	8.6.5.5.C	80	7.5.5.1.P	9.7.5.1.P
40	11.7.7.1.C	11.9.7.5.C	81	7.5.5.5.C	8.6.5.4.P
41	7.5.5.1.P	10.x.6.1.P	82	11.9.7.5.C	11.11.9.5.C

TABLE II—*Continued*

	Lefts	Rights		Lefts	Rights
83	9.x.5.5.P	11.x.7.5.C	98	7.5.5.1.C	7.5.5.3.C
84	8.6.5.5.C	8.6.5.5.C	99	10.9.6.5.P	11.9.7.5.C
85	7.5.5.5.C	7.9.5 <sup>t</sup> .5.C	100	9.7.5.1.C	9.7.5.2.C
86	9.8.5.5.C	11.9.7.4.C	101	7.5.5.1.P	9.7.5.3.P
87	9 <sup>t</sup> .7.5.5.P	11.9.7.5.C <sup>h</sup>	102	11.9.7.5.C	11.9.7.5.C
88	7.5.5.3.P	11.9.7.5.C	103	11.9.7.5.C	11.9.7.5.C
89	9.7.5.3.C	9.7.5.5.C	104	10 <sup>t</sup> .x.6.5.C <sup>h</sup>	11.10.8.5.C
90	9 <sup>t</sup> .7.5.2.C	8.6.5.3.C	105	9.7.5.5.C <sup>h</sup>	9.7.5.5.C
91	9.x.5.5.C	9 <sup>t</sup> .x.5.5.C	106	7.5.5.3.P	8.6.5.5.C
92	7.5.5.5.C	7.x.5.3.C	107	7.5.5.5.P	7.x.5.5.P
93	7.5.5.1.C	7.5.5.3.C	108	8.6.5.1.C	8.6.5.5.C
94	9 <sup>t</sup> .7.5.5.C	7.5.5.5.C	109	11.9.7.3.C	11.9.7.5.C
95	10.7.6.5.C	11.9.7.5.C	110	9.8.5.3.P	9.7.5.5.P
96	7.5.5.3.C	7.5.5.3.C	111	7.5.5.3.P	7.5.5.5.C
97	11.9.7.5.C	11 <sup>t</sup> .9.7.5.C	112	7.5.5.5.C	7.x <sup>t</sup> .5.5.C

The first thing that suggests itself in looking over these formulae is to compile the number of separate formulae that occur, arrange them in their natural order, and ascertain the occurrence of each both by sex and by side. There is probably no point in separating the two sexes as we have no reason for expecting sexual differences, other than possibly a long cultural differentiation in industries, but that the habitual difference in the use of the two sides is shown in a difference of formulation of rights and lefts has already been noticed. As this is a point of vital interest in some lines of biological thinking it will receive special consideration further on. We may, however, first present the data, beginning with the tabulated list of formulae, and the occurrence of each, Table III.

TABLE III

Formulae, with occurrence, of the 390 Japanese Palms of the two foregoing Tables.

Formula	Female Left	Female Right	Male Left	Male Right	Total
6 5 5 1 —	—	—	1	—	1
6 5 5 2 1	—	—	—	—	1
6 5 5 3 —	—	—	1	—	1
7 5 5 1 14	2	7	3	26	
7 5 5 2 2	—	—	—	2	
7 5 5 3 15	6	11	4	36	
7 5 5 4 —	—	3	1	4	
7 5 5 5 12	5	5	5	27	



TABLE III—*Continued*

Formula	Female Left		Female Right	Male Left	Male Right	Total
7 7 5 1	1	—	—	—	—	1
7 7 5 2	—	—	—	1	—	1
7 7 5 5	—	1	—	—	—	1
7 8 5 1	—	—	—	1	—	1
7 x 5 3	—	1	—	—	—	1
7 x 5 5	1	2	—	—	—	3
7 9 5 3	—	—	—	1	—	1
7 9 5 5	—	1	—	—	—	1
8 6 5 1	2	—	—	1	—	3
8 6 5 2	1	—	—	1	—	2
8 6 5 3	3	8	2	5	—	18
8 6 5 4	1	2	—	—	—	3
8 6 5 5	3	11	3	7	—	24
8 7 5 5	—	1	—	—	—	1
9 7 5 1	1	2	3	—	—	6
9 7 5 2	1	1	—	—	—	2
9 7 5 3	5	7	4	7	—	23
9 7 5 4	1	2	1	2	—	6
9 7 5 5	3	11	6	5	—	25
9 7 7 3	—	—	1	—	—	1
9 8 5 3	2	—	1	—	—	3
9 8 5 5	2	—	—	1	—	3
9 x 5 1	1	—	—	—	—	1
9 x 5 3	—	—	1	—	—	1
9 x 5 4	1	—	—	—	—	1
9 x 5 5	5	2	1	2	—	10
9 x 7 5	—	—	1	—	—	1
9 9 5 1	1	—	—	—	—	1
9 9 5 3	1	—	1	—	—	2
9 9 5 5	—	1	2	—	—	3
10 7 6 1	2	1	1	—	—	4
10 7 6 3	3	—	3	1	—	7
10 7 6 5	5	1	—	—	—	6
10 8 6 1	1	—	—	—	—	1
10 8 6 5	1	—	3	2	—	6
10 x 6 1	—	1	—	—	—	1
10 x 6 3	—	—	1	—	—	1
10 x 6 5	2	1	—	—	—	3
10 9 6 1	—	—	1	—	—	1
10 9 6 2	—	—	1	—	—	1
10 9 6 3	—	2	1	—	—	3
10 9 6 5	1	1	1	1	—	4
10 10 8 5	—	1	—	—	—	1

TABLE III—*Continued*

Formula					Female Left	Female Right	Male Left	Male Right	Total
11 x x 5	—	—	—	1	—	—	—	1	1
11 x 7 2	1	—	—	—	—	—	—	—	1
11 x 7 3	—	1	—	—	—	—	—	—	1
11 x 7 4	—	1	—	—	—	—	—	—	1
11 x 7 5	2	4	3	—	—	—	—	—	9
11 7 6 5	—	—	—	1	—	—	—	—	1
11 7 7 1	3	—	1	—	—	—	—	—	4
11 7 7 2	1	—	—	—	—	—	—	—	1
11 7 7 3	1	—	—	—	—	—	—	—	1
11 7 7 5	2	3	2	3	—	—	—	—	10
11 8 7 3	—	—	1	—	—	—	—	—	1
11 8 7 5	—	1	1	1	—	—	—	—	3
11 8 10 5	—	—	—	1	—	—	—	—	1
11 9 7 2	1	—	—	—	—	—	—	—	1
11 9 7 3	2	2	—	2	—	—	—	—	6
11 9 7 4	—	1	1	—	—	—	—	—	2
11 9 7 5	4	20	1	19	—	—	—	—	44
11 10 8 3	—	—	—	2	—	—	—	—	2
11 10 8 5	—	3	1	4	—	—	—	—	8
11 11 9 5	—	2	—	2	—	—	—	—	4
12 10 8 6	—	—	—	1	—	—	—	—	1
Totals	112	112	83	83	—	—	—	—	390

If now, based on the foregoing Table, we separate the individual formulae into their Main Lines, and compile the total occurrence of each termination number in each Line, we get Table IV, with naturally 390 separate instances in the case of each.

TABLE IV  
Terminations of the four Main Lines in 390 Japanese Palms.

Termination Number	Line A	Line B	Line C	Line D
1	51	—	—	—
2	12	—	—	—
3	109	—	—	—
4	17	—	—	—
5	200	246	98	—
6	1	39	50	3
7	—	87	101	105
x	—	1	36	—
8	—	12	19	51
9	—	4	70	89
10	—	1	12	39
11	—	—	4	102
12	—	—	—	1
	390	390	390	390

In order to see just what we have in this maze of figures, and for a readier comparison with results of other observers, and from other races, this Table is best converted into percentages, as is shown in Table V.

TABLE V

The results of Table IV, changed into percentages, for comparison with the next following table.

Termination Number	Line A	Line B	Line C	Line D
1	13.1%	—	—	—
2	3.1	—	—	—
3	27.9	—	—	—
4	4.4	—	—	—
5	51.3	63.1	25.1	—
6	0.25	10.0	12.8	0.7
7	—	22.3	25.9	26.9
x	—	0.1	9.2	—
8	—	3.1	5.0	13.1
9	—	1.0	18.0	22.8
10	—	0.25	3.1	10.0
11	—	—	1.0	26.2
12	—	—	—	0.25

With this may be compared directly Hasebe's percentile table (*l. c.*; p. 24) of terminations of the Main Lines in 552 Japanese palms (430



male and 122 female) except that here the sexes are separate. This table of Hasebe's is as follows:

TABLE VI

Hasebe's percentile table of terminations of the four Main Lines in 430 male, and 122 female Japanese palms.

Termination Number	Line A		Line B		Line C		Line D	
	Males	Females	Males	Females	Males	Females	Males	Females
1	10.7	10.7	—	—	—	—	—	—
2	0.5	1.6	—	—	—	—	—	—
3	30.5	32.8	0.2	—	—	—	—	—
4	5.6	8.2	0.7	—	0.2	—	—	—
5	51.6	46.7	66.7	73.9	35.1	32.8	—	—
6	—	—	1.4	3.3	0.5	0.8	—	—
7	—	—	28.6	21.3	21.6	24.6	37.0	35.2
x (=8)*	—	—	—	—	8.1	11.5	0.5	0.8
x (=x)*	—	—	0.2	0.8	17.4	15.6	0.9	—
8	—	—	0.5	0.8	—	—	0.7	0.8
9	—	—	1.6	—	14.9	13.9	30.2	37.7
10	—	—	—	—	0.5	0.8	1.4	3.3
11	1.2	—	—	—	1.6	—	29.3	22.1

\*In Hasebe's use the symbol  $x$  signifies a rudimentary, though evident, condition; ( $x$ ), a complete loss of the line. In my usage, a rudimentary, though evident, Line C is designated by an 8; a complete loss by an  $x$ , without brackets.

It is probable that Hasebe's care in separating the sexes has been rather needless, and that he would have gotten more definite results, and avoided a lot of superfluous figures, by amalgamating the sexes, and presenting the results of his 552 palms without sex distinction. By using the combined results of both of us, 552+390, we get the complete records of 942 separate Japanese palms, a larger number than exist of any except those of the European-Americans, and even here the recorded results, all told, deal with fewer individuals.

In general, too, the correspondences between his results and mine are fairly close, and serve as the best tests thus far of the methods used.

The main discrepancies concern themselves with small figures, often with an actual decimal, less than unity, where its presence and absence in the two tables seem important, but are actually due to the presence in one collection of a single palm with an unusual character, not likely to occur in even 1000 single cases. On the other hand there is much general correspondence, such as the unusual termination of 1 for Line

A. This in the Caucasian palm is practically non-occurrent, but Hasebe notes it in 10.7% of the total cases in both sexes, and I in 13.0% of all cases, thus forming a definite racial character for these Oriental people.

Employing this table of his, together with similar percentile tables that have been made out for other races (Loth, Schlaginhaufen, myself) Hasebe now prepares a comparative table of the terminations of the Main Lines in all the races thus far studied, but although this application of the method by comparing the results of large numbers from each of the given races, might eventually become definite in its results, with the small numbers thus far available it can hardly be absolutely trustworthy, still it is a most meritorious attempt to actually use these characters as racial criteria, and the only question is whether they are sufficiently reliable to be followed in those cases that occur but rarely, and consequently give but small percentages. Thus far it is my opinion that only such of the commoner characteristics, like the large percentage of Termination 1 in Line A, just mentioned, may be used as actual criteria, while little should be based upon the more unusual characters with percentages less than perhaps 10. Nevertheless, it is a hard thing to define, or limit, the value of such characters, and the occurrence of a peculiarity that may have been seldom observed, and then always and only in a single race, might certainly have a very definite significance.

TABLE VII

Terminations of the four Main Lines in my collection of Japanese palms (83 males; 112 females), divided according to sex.

Termination Number	Line A		Line B		Line C		Line D	
	Males	Females	Males	Females	Males	Females	Males	Females
1	19	32	—	—	—	—	—	—
2	3	9	—	—	—	—	—	—
3	50	59	—	—	—	—	—	—
4	8	9	—	—	—	—	—	—
5	85	115	100	146	41	57	—	—
6	1	—	17	20	19	31	2	1
7	—	—	38	52	42	59	42	63
x	—	—	1	—	10	26	—	—
8	—	—	8	4	12	7	19	32
9	—	—	2	2	32	38	39	50
10	—	—	—	—	8	4	16	23
11	—	—	—	—	2	2	47	55
12	—	—	—	—	—	—	1	—
	166	224	166	224	166	224	166	224

To complete the study of the terminations of the Main Lines in the Japanese two further Tables are needed, the one (Table VII) divided, like those of Hasebe, according to sex; the other (Table VIII) without sex distinction but separating the right and left sides. These are not percentile but give the actual number of instances that occur in my collection.

TABLE VIII

Terminations of the four Main Lines in my collection of Japanese palms (83 males; 112 females), divided in accordance with rights and lefts, without distinction of sex.

Termination Number	Line A		Line B		Line C		Line D	
	Lefts	Rights	Lefts	Rights	Lefts	Rights	Lefts	Rights
1	42	9	—	—	—	—	—	—
2	11	1	—	—	—	—	—	—
3	61	48	—	—	—	—	—	—
4	8	9	—	—	—	—	—	—
5	73	127	138	108	72	26	—	—
6	—	1	27	10	17	33	3	—
7	—	—	29	61	52	49	74	31
x	—	—	—	1	20	16	—	—
8	—	—	1	11	13	11	17	34
9	—	—	—	4	20	50	46	43
10	—	—	—	—	1	6	27	12
11	—	—	—	—	—	4	28	74
12	—	—	—	—	—	—	—	1
	195	195	195	195	195	195	195	195

## 1b THE FOUR MAIN LINES OF THE CHINESE

A set of prints, taken from fifty male Chinese (100 separate palms), was made up from the collections taken at Shanghai College, but as they were not all beyond possible doubt in some essential particulars, and as the exact number of fifty was especially desired on account of making a percentile reckoning easier, this collection was reinforced by certain of the old prints of laundrymen previously in my possession, and already used in the paper of 1904. These were undoubtedly Cantonese, and form the first seven of the list. The rest are all Shanghai College students, and are drawn from all parts of the nation.

In the fifty pairs thus selected the general Hand Formulae, expressing the terminations of the four Main Lines, together with the condition at or near the wrist (presence or absence of a carpal triradius), are the following:



TABLE IX  
Palm Formulae of 50 Chinese Males

Cat. No.	Lefts	Rights
299	7 5 5 2 P	8 6 5 3 P
300	7 5 5 5 C	8 6 5 5 C
301	7 5 5 3 C	8 6 5 3 C
314	7t 5 5 5 P	10 x 6 5 C
315	9 7 5 3 P	9 8 5 3 P
316	11 8 7 1 C	11 x 7 5 C
318	10 7 6 3 C	10 7 6 5 ?
1302	7 5 5 5 C	10 7 6 3 P
1303	7t 7 5t 3 P	7t 7 5 5 P
1304	7 5 5 3 P	9 7 5 4 P
1305	7 5 5 1 C	7 5 5 4 C
1306	7 5 5 3 C	7 5 5 5 C
1308	7 5 5 1 P	7 9 5 3 P
1309	9 7 7 1 P	9 7 5 3 C
1310	7 5 5 3 ?	9 7 5 3 ?
1311	9 x 5 3 P	10 7 6 5 P
1312	9 7 5 3 P	9 7 5 5 P
1313	10 7 6 5 C	10 7t 6 5 C
1314	7 5 5 1 C	9 7 5 3 C
1315	11 7 7 5 C	11 9 7 5 C
1316	11 7 7 1 C	11 8 7 5 C
1319	10 7 6 3 P	11 9 7 5 C
1320	7 5 5 3 C	7 5 5 3 C
1321	7 5 5 1 P	8 6 5 5 P
1323	8 6 5 3 P	8 6 5 3 C
1326	7 5 5 3 C	8 6 5 5 C
1328	9 x 5 3 P	10 7 6 3 ?
1331	9t 7 5 3 C	11 <sup>12</sup> 9 7 <sup>6</sup> 5 C
1332	10 7 6 3 P	11 9 7 5 P
1333	7 5 5 3 C	8 6 5 3 C
1334	8 6 5 3 P	9 7 5 5 P
1336	7 5 5 3 C	9 7 5 3 C
1338	7 5 5 1 C	7 5 5 3 C
1340	7 5 5 2 C	9 <sup>8</sup> 7 5 <sup>6</sup> 3 C
1341	7 5 5 3 P	9 7 5 5 C
1343	11 7 7 1 C	11 9 7 5 C
1344	x 5 5 5 P	7 5 5 5 ?
1345	9 7 5 3 C	9t 7 5 5 C
1346	7t x 5 5 C	9 x 7 5 C
1347	10 x 6 3 C	9 7 5 5 C
1348	9 7 5 3 P	11 9 7 5 P
1350	9 7 5 5 C	9 7 5 5 C
1351	7 5 5 1 C	7 5 5 5 C

TABLE IX—*Continued*

Cat. No.	Lefts					Rights				
1352	9	7	5	1	C	9	7	5	1	C
1354	7 <sup>a</sup>	5 <sup>b</sup>	5	3	P	9	x	5	5	P
1355	11	8	7t	5	C	11	7	5	5	C
1357	10	9	6t	3	C	7	5	5	5	C
1362	11	x	7	5	C	11	10	8	5	C
1363	7	6	5	5	C	10	7	6	5	C
1364	7	x	5	3	?	10	9	6	5	C

In the same way the palm prints of fifty Chinese females were selected from the collection of Miss Yang Ging-Hsioh, and the general Hand Formulae of these, mainly taken from individuals from Shanghai, Province of Kiang-Su, are also presented here (Table X).

TABLE X  
Palm Formulae of 50 Chinese Females

Cat. No.	Lefts					Rights				
1404	8	6	5	3	P	9	7	5	3	P
1405	7	5	5	3	C	7	5	5	5	C
1406	9	7	5	3	C	7	5	5	5	C?
1407	7	5	5	1	C	7	5	5	5	P
1408	7	5	5	3	C	9	7	5	5	C
1410	9	7	5	3	P	11	9	7	5	P
1411	9	7	5	5	P	11	7	7	5	P
1412	9	7	5	5	P	9	9	5	5	?
1413	10	7	6	5	C	9	7	5	5	C
1414	7	5	5	1	C	8	6	5	1	C
1415	9	x	5	3	C	10	7	6	5	C
1416	9	7	5	5	P	10	9	6	5	P
1417	7	5	5	1	C	9	7	5	1	C
1418	8	6	5	2	C	9	7	5	5	C
1419	7	5	5	3	?	9	7	5	3	C
1421	7	5	5	1	C	7	9	5	5	C
1422	9	7	5	5	P	9	7	5	5	P
1423	9	7	5	5	C	10	9	6	5	C
1424	10t	9	6t	4	C	11t	9	7	4	C
1425	10	8	5	3	P	9	7	5	3	P
1426	7	5	5	3	C	9	7	5	3	P
1427	7	5	5	3	C	9	7	5	3	C
1428	7	5	5	1?	P	9	7	5	3	P
1429	9	7t	5	3	C	11	9	7	5	C?
1430	10	7	6	3	P	11	7	7	5	C
1431	7	5	5	1	C	10	7	6	5	C
1432	8	6	5	3	P	7	9	5	3	P

TABLE X—Continued

Cat. No.	Lefts				Rights			
1433	8	6	5	2 C	9	7	5	3 P
1434	11	9	7	5 C	11	8	7	5 C
1435	7	5	5	1 C	9	7	5	5 C
1436	10	x	6	5 P?	11	x	7	5 C
1437	6!	5	5	1 C	7	5	5	3 C
1439	9	x	5	5 C	9	x	5	5 C
1440	7	5	5	3 C	9	7	5	5 C
1442	7	5	5	1 C	7	5	5	1 C
1443	9	x	5	1 C	9	x	5	5 C
1444	9	7	5	5 C	9	x	7	3 C
1445	7t	7	5	5 C	7	5	5	3 C
1446	8	6	5	1 C	10	7	6	1 C
1449	7	5	5	3 C	9	7	5	5 C
1450	7	5	5	1 C	8	6	5	1 C
1451	9	8	7	5 C	9	8	7	5 C
1452	9	7	7	3 C	9	9	7	3 C
1453	9t	7	7	3 C	11	9	7	5 ?
1454	10	7	6	2 C	8	6	5	2 C
1455	7	5	5	3 C	9	7	5	5 C
1456	9	7	5	5 C	9	x	5	5 P
1457	7	5	5	1 C	9	7	5	3 C
1458	7	5	5	5 C	7	5	5	5 C
1459	7	5	5	5 C	8	6	5	5 C

In the same way as with the Japanese a table is now presented, giving the formulae arranged consecutively; also the occurrence of each in both males and females, and upon both sides (Table XI). This is followed by separate tabulations of the terminations for each of the Main Lines, and divided in two ways; according to sex (Table XII), and according to lefts and rights (Table XIII). These correspond respectively to Tables VII and VIII for the Japanese.

TABLE XI  
Distribution of Formulae in Chinese Palms  
(50 Males; 50 Females)

Formulae	lefts	Males rights	both	lefts	Females rights	both	Total repre- sentation both hands, both sexes
6 5 5 1	—	—	—	1	—	1	1
7 5 5 1	6	—	6	10	1	11	17
7 5 5 2	2	—	2	—	—	—	2
7 5 5 3	10	2	12	8	2	10	22
7 5 5 4	—	1	1	—	—	—	1
7 5 5 5	3	4	7	2	4	6	13
7 6 5 5	1	—	1	—	—	—	1



TABLE XI—Continued

Formula	lefts	Males rights	both	lefts	Females rights	both	Total repre- sentation both hands, both sexes
7 7 5 3	1	—	1	—	—	—	1
7 7 5 5	—	1	1	1	—	1	2
7 x 5 3	1	—	1	—	—	—	1
7 x 5 5	1	—	1	—	—	—	1
7 9 5 3	—	1	1	—	1	1	2
7 9 5 5	—	—	—	—	1	1	1
8 6 5 1	—	—	—	1	2	3	3
8 6 5 2	—	—	—	2	1	3	3
8 6 5 3	2	4	6	2	—	2	8
8 6 5 5	—	3	3	—	1	1	4
9 7 5 1	1	1	2	—	1	1	3
9 7 5 3	5	5	10	3	8	11	21
9 7 5 4	—	1	1	—	—	—	1
9 7 5 5	1	6	7	7	8	15	22
9 7 7 1	1	—	1	—	—	—	1
9 7 7 3	—	—	—	2	—	2	2
9 8 5 3	—	1	1	—	—	—	1
9 8 7 5	—	—	—	1	1	2	2
9 x 5 1	—	—	—	1	—	1	1
9 x 5 3	2	—	2	1	—	1	3
9 x 5 5	—	1	1	1	3	4	5
9 x 7 3	—	—	—	—	1	1	1
9 x 7 5	—	1	1	—	—	—	1
9 9 5 3	—	—	—	1	—	1	1
9 9 5 5	—	—	—	—	1	1	1
9 9 7 3	—	—	—	—	1	1	1
10 7 6 1	—	—	—	—	1	1	1
10 7 6 2	—	—	—	1	—	1	1
10 7 6 3	3	2	5	1	—	1	6
10 7 6 5	1	4	5	1	2	3	8
10 x 6 3	1	—	1	—	—	—	1
10 x 6 5	—	1	1	1	—	1	2
10 9 6 3	1	—	—	—	—	—	1
10 9 6 4	—	—	—	1	—	1	1
10 9 6 5	—	1	1	—	2	2	3
11 7 5 5	1	1	2	—	—	—	2
11 7 7 1	2	—	2	—	—	—	2
11 7 7 5	1	—	1	—	2	2	3
11 8 7 1	1	—	1	—	—	—	1
11 8 7 5	1	1	2	—	1	1	3
11 x 7 5	1	1	2	—	1	1	3
11 9 7 4	—	—	—	—	1	1	1
11 9 7 5	—	6	6	1	3	4	10
11 10 5 5	—	1	1	—	—	—	1
TOTALS	50	50	100	50	50	100	200

TABLE XII

Terminations of the four Main Lines in my collection of Chinese palms (50 males; 50 females), divided according to sex.

Termination Number	LINE A		LINE B		LINE C		LINE D	
	Males	Females	Males	Females	Males	Females	Males	Females
1	12	18	—	—	—	—	—	—
2	2	4	—	—	—	—	—	—
3	41	31	—	—	—	—	—	—
4	2	2	—	—	—	—	—	—
5	43	45	69	74	28	28	—	—
6	—	—	15	11	10	9	—	1
7	—	—	16	15	38	38	34	30
8	—	—	—	—	4	3	9	9
x	—	—	—	—	10	9	—	1
9	—	—	—	—	9	13	26	40
10	—	—	—	—	1	—	14	11
11	—	—	—	—	—	—	16	9
	100	100	100	100	100	100	100	100

TABLE XIII

Terminations of the four Main Lines in my collection of Chinese palms (50 males; 50 females), divided according to rights and lefts, without distinction of sex.\*

Termination Number	LINE A		LINE B		LINE C		LINE D	
	Lefts	Rights	Lefts	Rights	Lefts	Rights	Lefts	Rights
1	24	6	—	—	—	—	—	—
2	5	1	—	—	—	—	—	—
3	44	28	—	—	—	—	—	—
4	1	3	—	—	—	—	—	—
5	26	62	78	65	42	14	—	—
6	—	—	11	15	8	11	1	—
7	—	—	11	20	32	44	46	18
8	—	—	—	—	3	4	7	11
x	—	—	—	—	10	9	1	—
9	—	—	—	—	5	17	26	40
10	—	—	—	—	—	1	12	13
11	—	—	—	—	—	—	7	18
	100	100	100	100	100	100	100	100

\*As the number of individual palms used in this and the previous tables is exactly 200, the actual figures, halved, give the percentile values. They may, thus, with but little trouble, be directly compared with Tables V and VI, for the Japanese, and with Table XV, for European-Americans.

## 1c THE FOUR MAIN LINES OF EUROPEAN-AMERICANS

A table, similar to Tables III and XI of the present paper, giving the formulae of 100 individuals of the "white" race, but not so detailed, was published in the *Popular Science Monthly* for September 1903, and reprinted in the *American Anthropologist* for April-June, 1904, p. 292,

TABLE XIV

Main Line Formulae of 200 European-American Females (400 separate Palms)  
(This Table consists of a combination of two previously published ones, each consisting of 100 Smith College students, not duplicates.)

Formulae	Lefts	Rights	Both	Formulae	Lefts	Rights	Both
7 5 3 2	2	0	2	10 7 6 4	1	1	2
7 5 5 2	4	0	4	10 7 6 5	7	10	17
7 5 5 3	11	2	13	10 7 8 3	1	0	1
7 5 5 4	3	4	7	10 8 6 3	0	1	1
7 5 5 5	5	7	12	10 8 6 5	3	3	6
7 7 5 5	1	0	1	10 9 6 1	1	0	1
7 8 5 5	1	0	1	10 9 6 2	3	0	3
7 9 5 3	1	0	1	10 9 6 3	3	0	3
7 9 5 4	1	1	2	10 9 6 4	1	2	3
7 9 5 5	2	2	4	10 9 6 5	4	7	11
8 6 5 1	1	0	1	10 10 6 5	0	1	1
8 6 5 2	2	0	2	10 10 8 5	0	1	1
8 6 5 3	12	5	17	11 7 5 3	1	0	1
8 6 5 4	0	1	1	11 7 5 5	1	0	1
8 6 5 5	3	8	11	11 7 7 1	1	0	1
8 7 6 5	0	1	1	11 7 7 2	1	0	1
9 7 5 1	1	0	1	11 7 7 3	3	2	5
9 7 5 2	4	2	6	11 7 7 4	2	0	2
9 7 5 3	10	4	14	11 7 7 5	12	7	19
9 7 5 4	2	7	9	11 8 7 2	1	2	3
9 7 5 5	12	25	37	11 8 7 3	1	1	2
9 7 7 4	1	0	1	11 8 7 4	0	2	2
9 7 7 5	3	0	3	11 8 7 5	12	6	18
9 8 5 3	4	2	6	11 8 9 5	0	1	1
9 8 5 4	1	0	1	11 9 7 2	0	1	1
9 8 5 5	6	3	9	11 9 7 3	2	4	6
9 8 7 5	3	1	4	11 9 7 4	4	3	7
9 9 5 3	1	0	1	11 9 7 5	20	52	72
9 9 5 5	6	4	10	11 10 8 4	1	0	1
9 10 8 5	0	1	1	11 10 8 5	2	12	14
10 7 6 2	8	0	8	11 11 8 5	0	1	1
10 7 6 3	1	0	1				
	Totals			63	200	200	400



in the first article of the series on racial characters in palms and soles. A similar table, also presenting the formulae of 100 "whites" appeared in the second article of the series, *American Anthropologist*, April-June, 1913, p. 196. A third table of the same race, and with the same number of individuals, was published in *Personal Identification* (Badger, Boston, 1918, p.150), and as these were wholly composed of different individuals (with possibly a few duplicates in the first two) we have a convenient series of European-Americans for study and comparison. As these were all collected from Smith College students the problem of sex is eliminated and the individuals used are all female.

For use here the two tables of 1913 and 1918 just referred to have been put together, on the probable assumption that they contain no duplicates and the result is shown in Table XIV, which gives the Main Line Formulae of 200 European-American females.

TABLE XV

Terminations of the four Main Lines in the 400 European-American Palms (females) of the previous table. This is to be compared with Tables V and VI (Japanese), and with Tables XII and XIII (Chinese); and as it uses just 400 separate palms, a division of each number by 4 will make it percentile, and allow a direct comparison.

Termination Number	LINE A	LINE B	LINE C	LINE D
1	4	—	—	—
2	30	—	—	—
3	72	2	—	—
4	38	—	—	—
5	256	173	38	—
6	—	58	32	—
7	—	147	132	47
8	—	19	54	33
9	—	1	125	103
10	—	—	18	59
11	—	—	1	158
	400	400	400	400

#### 1d THE DISCUSSION OF RACIAL DIFFERENCES IN THE FOUR MAIN LINES

We are now ready for a discussion of the Main Lines in the three races here treated, having a sufficient number of each to determine (1) if there are distinct racial differences in these parts, and (2) what they are.

From Tables V, VI, XII, XIII, and XV we can get the actual number of representatives of each formula in each race, and in calculating this similar formulae, like 7 5 5 3, 7 5 5 4, and 7 5 5 5, should be treated

together. We may consider, in this way, three sets of formulae, which together form the bulk of all Main Line formulae of all races, so far as is at present known. These are the Seven-five-five-five series, the Nine-seven-five-five-series, and the Eleven-nine-seven-five series, each with their several variants.

First taking the *Chinese* we get the following results in the occurrence of common formulae:

*Chinese* (200 separate palms)

7 5 5 1=17	9 7 5 1= 3	11 x 7 5= 3
7 5 5 2= 2	9 7 5 3=21	11 8 7 1= 1
7 5 5 3=22	9 7 5 4= 1	11 8 7 5= 3
7 5 5 4= 1	9 7 5 5=22	11 9 7 4= 1
7 5 5 5=13	—	11 9 7 5=10
—	47 (23.5%)	—
55 (27.5%)		18 (9.0%)

*Japanese* (390 separate palms)

7 5 5 1=26	9 7 5 1= 6
7 5 5 2= 2	9 7 5 2= 2
7 5 5 3=36	9 7 5 3=23
7 5 5 4= 4	9 7 5 4= 6
7 5 5 5=27	9 7 5 5=25
—	—
95 (24.3%)	62

To these may be added the formulae in which an x has replaced the 7 in the second term, which adds 13 more cases, as follows:

9 x 5 1= 1
9 x 5 3= 1
9 x 5 4= 1
9 x 5 5=10
13

When these last are added we get a total of 75 or 19%.

11 9 7 2= 1
11 9 7 3= 6
11 9 7 4= 2
11 9 7 5=44
53

Here also we may add those with the second figure represented by x.

11 x 7 2= 1
11 x 7 3= 1
11 x 7 4= 1
11 x 7 5= 9
12

The total becomes thus 65, or 16.6%.

*European-Americans* (400 separate palms)

7 5 5 2= 4	9 7 5 1= 1	11 9 7 2= 1
7 5 5 3=13	9 7 5 2= 6	11 9 7 3= 6
7 5 5 4= 7	9 7 5 3=14	11 9 7 4= 7
7 5 5 5=12	9 7 5 4= 9	11 9 7 5=72
—	9 7 5 5=37	—
36 (9.0%)	—	86 (21.5%)
	67 (16.75%)	

To these last we may add the similar formulae with 8 in the second term:

11 8 7 2= 3
11 8 7 3= 2
11 8 7 4= 2
11 8 7 5=18
—
25 (6.2%)

which gives as the total here 111 separate palms out of 400, or 27.7%, making this essentially the *European-American formula*, as has been already claimed in previous papers.

In the same way the largest percentages in the Chinese group around the formulae 7 5 5 5, and 9 7 5 5, while the representation of 11 9 7 5 and related forms is very small. In the negroes, it will be remembered, by far the commonest formula groups around 7 5 5 5, being about 85% of the entire list.

When compared with these two distinct races, represented by the Chinese and the European-Americans, the Japanese seem to hold an intermediate position, or, more exactly, as if their population consisted largely of a Chinese, or at least a Mongolian, substratum, to which has been added a fairly large element of a stock related to the European-Americans, a conclusion which tallies perfectly with what we know concerning Japanese origins. The extraneous element, not Mongolian, may easily have come from the aborigines of the islands, the Ainos, and very likely from the inhabitants of the neighboring peninsula, Cho-Sen (Korea). A Malay admixture, too, is not improbable, but for this we greatly need the palm and sole prints of undoubted Malay peoples, which are thus far entirely wanting.

Putting all these final results together in the form of a table, both for easy reference, and to present in concentrated form the definite conclusions thus far drawn from the Main Lines, we present Table XVa.



TABLE XVa

The commonest Main Line formulae in the palms of Chinese, Japanese, and European-Americans, with their percentages.

Name of Race or People	Number of individual palms studied	Seven-five-five series	Nine-seven-five series	Eleven-nine-seven-five series
Chinese	200	55 (27.5%)	47 (23.5%)	18 (9.0%)
Japanese; H. H. W	390	95 (24.3%)	75 (19.0%)	65 (16.6%)
European-Americans	400	36 (9.0%)	67 (16.75%)	111 (27.7%)

The next consideration will be a comparison of the terminations of the four Main Lines in the different peoples. These may be comprehensively expressed in the form of a percentile table, taken from several of those previously given, and collected in one place for easy comparison. These results are compiled from Tables V, VI, XII, XIII and XV, reduced to percentages where necessary. Hasebe's results are divided according to sex, as he gives them that way, but the similarity of the two show quite conclusively that such a distinction is not necessary.

TABLE XVb

Percentile Table of the Occurrence of the different Terminations in the various peoples considered here.

## LINE A

Race	1	2	3	4	5
Japanese (H. H. W.)	13.1	3.1	27.9	4.4	51.3
Japanese (Hasebe)	10.7/10.7	0.5/1.6	30.5/32.8	5.6/8.2	51.6/46.7
Chinese	15.0	3.0	36.0	3.0	44.0
European-Americans	1.0	7.5	18.0	9.5	64.0

## LINE B

Race	3	4	5	6	7	8	9
Japanese (H. H. W.)			63.1	10.0	22.3	3.2	1.0
Japanese (Hasebe)	0.2/-	0.7/-	66.7/73.9	1.4/3.3	28.6/21.3	0.5/0.8	1.6/-
Chinese			71.5	13.0	15.5		
European-American	0.5		43.25	14.5	36.75	4.75	/25

## LINE C

Race	5	6	7	8	9	10	11
Japanese (H. H. W.)	25.1	12.8	25.9	9.2	5.0	18.0	3.1
Japanese (Hasebe)	35.1/32.8	0.5/0.8	21.6/24.6	17.4/15.6	8.1/11.5	14.9/13.9	0.5/0.8
Chinese	28.0	9.5	38.0	3.5	9.5	11.0	0.5
European-American	9.5	8.0	33.0		13.5	31.25	4.5

TABLE XVb

## LINE D

Race	6	7	8	9	10	11	
Japanese							
H. H. W.	0.7	26.9	13.1	22.8	10.0	26.2	
Japanese (Hasebe)	—/—	37.0/35.2	0.9/—	1.2/1.6	30.2/37.7	1.4/3.3	29.3/22.1
Chinese	0.5	32.0	9.0	33.0	12.5	12.5	
European- American		11.75	8.25	25.75	14.75	39.5	

From the table we see at once that Hasebe's results, and mine, the one based upon 552 separate palms, the other upon 390, correspond quite closely, the slight differences being easily accounted for by the rather small number of cases in both collections. Evidently a much larger number would be required to get a fixed result, probably several thousand, yet the correspondences encourage us to think well of the method, and to hope that by means of it actual racial differences may ultimately be established.

What has seemed the most striking single feature of both Japanese and Chinese palms when working them over the first time, has been the general tendency of the lines from the thenar side of the palm to drop downwards towards the wrist, and even beyond. This is seen most clearly in the frequency with which Line A terminates upon the thenar side of the carpal triradius, a rare thing in European-Americans. In the latter this is a bare 1%, but in my Japanese it appears in 13.1%, and in those of Hasebe 10.7% in each sex, and in my Chinese the percentage has actually risen to 15.0%.

The same tendency is shown in the percentile occurrence of terminal position 3 for this same Line, which is but 18% in European-Americans, as compared with about 30% in the Japanese, and 36% in the Chinese.

Generalizing from these figures we may now state definitely that *a liability for Line A to assume a low position is a definite character of the Mongolian palm, whether Japanese or Chinese.*

This character, in its turn, is merely the expression of a larger movement, for Line B is also affected, and in Mongolians is more apt to come to the margin of the hand, and less likely to curl up to the base of the fingers, than in European-Americans. Thus, compare the frequency with which Line B terminates at 5 in the three races; 63% in my Japanese collection, between 66 and 73% in Hasebe's, and but 43.25 in European-Americans. Even Line C, which in the latter rarely comes to the free edge of the palm, (19.5%) shows in Japanese lists between 25 and 35%.

Many other differences in Main Line terminations may be deduced from this table of terminations (Table XVb); for instance the high percentage in our own race of Line D in position 11 (39.5%) as compared with the Japanese in the 20's, and the Chinese at 12.5%. When we seek to know just where Line D has gone in the Mongolian palm to compensate for the great frequency of position 11 in the European-American, we find by a further consultation that this position is at 7, for which the Japanese and Chinese are about at 27-37%, where the European-Americans do not exceed 12%.

Before leaving the subject of the Main Lines it may be well to take up a well-known difference between the two sides, a condition certainly correlated with the preferential use of the right hand over the left. In all the races thus far studied there has been noticed a more frequent occurrence of the formula 11 9 7 5, with its variants in the right hand.

Thus, in the European-Americans, in which it is the characteristic formula, this formula, together with the similar one where the second term is 8, and those where the termination of Line A varies, occurs 111 times in 400 palms, or 27.7%; and of these 71 are in right hands. In 390 Japanese palms this formula, with variants, occurs 65 times, of which 50 are rights, and in the 18 hands of Chinese with the same formula, 14 of them are right. The condition in the hands studied here is as follows:

TABLE XVc

Percentages of occurrence of the formula 11.9.7.5 and its variants in the left and right hands.

Race	Total No.	Rights	Lefts	Both	Percent R.	Percent L.	Percent Both
Japanese (H.H.W.)	390	50	15	65	12.8%	3.5%	16.6%
Japanese (Hasebe)	552	84	41	125	15.2	7.4	22.6
Chinese	200	14	4	18	7.0	2.0	9.0
European-Americans	400	71	40	111	17.7	10.0	27.7
Aino (Hasebe)	110	22	11	33	20.0	10.0	30.0

The reader cannot fail to notice, 1) that this formula is not a common one among the pure Mongolians. In the Chinese its percentile occurrence is but 9.0%; 2) that in the Japanese, where Caucasian blood is probable, the percentage is increased to 16.6% (mihi) or to 22.6% (Hasebe); 3) that the Ainos are in the same respect practically identical with the European-Americans, 30.0% compared with 27.7%. The most important fact, however, which may be taken in connection with



the investigation of several other peoples, is the predominance of this pattern in right hands. Physiologically and mechanically this formula represents the best adaptation to the average human uses to which the hand is put, the position to which the ridges would be placed if they were actually pushed through direct use. The peoples other than those given here, in which this formula predominates in right hands are, the Poles, Farther Indians, and Negroes from the United States. In Liberian Negroes, and in Maya Indians this formula has not yet been recorded. There are no peoples yet found in which the left hand predominates in this particular.

Finally, in seeking for the most frequent formula or group of formulae, a careful count compels us to declare in favor of 7 5 5 x, which allows some latitude for the termination of Line A. In my Chinese collection this formula occurs in 55 out of 200 palms, or 27.5%. This formula, even much more abundant in the African negroes, I have formerly called the "Negro Formula," but after a count of its frequency among the Chinese this phrase is of doubtful value. It seems more likely that the formula 7 5 5 x is a very common one for all races of men, and that in the negro it is well nigh universal.

A better formula to serve as the distinctive "Mongolian Formula," and one which in the Chinese and Japanese as well is but little less frequent than the 7 5 5 x, is the 9 7 5 x group. This appears in 23.5% of my Chinese, and in 19% of my Japanese. In the European-Americans it occurs in 16.6% of all cases, and thus the Japanese, as in many other characters, form a connecting link between the true Mongolians and the Caucasians. Hasebe finds a proportion of 10.9% exactly (the formula 9 7 5 5) for both Japanese and Aino, but does not include the related formulae, as has been done in this paper. On the whole, much as we would like to, we can hardly see our way to designating any formula as definitely the "Mongolian," but if we were compelled to do so, and excepting the generalized "human" type, 7 5 5 x, we might give it as 9 7 5 5, or, still better, 9 7 5 1, because of the position 1 for Line A, which is so common among Mongolian peoples, and apparently so unusual elsewhere.

## 2 THE OCCURRENCE OF PATTERNS

### 2a PATTERN FORMULAE IN GENERAL, AND A METHOD OF WRITING THEM

A satisfactory Pattern-formula, that is, a descriptive formula, expressing the exact condition of the patterns and pattern vestiges, has not yet been devised, but an attempt is made here to express the condi-

tions found in the few hundred palms here studied, and for this limited number it is found to work fairly well. To explain this we may consider the pattern areas and other features one at a time, and enumerate what variations there have been found thus far. As, by means of exponent letters and other devices, it applies to and explains every condition here found, it may well serve as the basis for the pattern formula sought, but will require to be applied in many more hundreds of cases before it is perfected, or may be considered of universal and complete application.

*Carpal triradius.* Typically this point appears as an equilateral triangle, placed upon or near the border of the wrist, on the distal margin of the print, and about midway between the Thenar and Hypothenar eminences. This is designated as C. Occasionally it is placed very low down, and barely comes within the limits of a print, and it may be supposed that sometimes, when actually present on a hand, it does not print at all. It may in such cases often be made out, or its presence established, by the direction of the lines along the border. Here, or otherwise when placed very low, the letter C may be modified by the exponent 1 (low).

When there is definitely no carpal triradius, and when the lines come around the wrist from the two sides and flow together into a single system by simple contact the condition is called a *parting*, and designated by the letter P. This is confessedly in some cases difficult or impossible to distinguish from those in which there is a very low triradius, placed below the area that actually prints, but in general, or when a print is sufficiently extended proximally to get the friction-skin entirely in the field, the distinction is clear enough.

More genuine embarrassment is felt in the case of a triradius that lies high up in the hand, along the radial border of the Hypothenar area, and may not always be morphologically the same thing. It may be designated as C<sup>h</sup> (high), but may be often explained as the last vestige of a "degeneration-triradius," formed in the evolutionary series after the spreading out of an S-shaped figure, with the expansion of its two loops, and the formation of this triradius, with its transverse radiant, to serve to separate the two. If we consider this point as resulting in such a way we may designate it as C<sup>d</sup> (degeneration), but, as it may not be always clear just what this point is in its development, it is probable in practice that a formula writer may use indiscriminately either of these two designations.

*Hypothenar pattern.* This is commonly a loop, opening upwards (a), outwards, i. e., ulnarwards (b), or downwards and inwards, radially (c), and, as the pattern is naturally called H, this gives for the three forms, H<sup>a</sup>, H<sup>b</sup>, and H<sup>c</sup>. There may be also the whorl (H<sup>w</sup>) and the S-shaped figure (H<sup>s</sup>), and this latter may be spread out so completely as to form two loops, facing in opposite directions. Lastly, either one of these loops may degenerate or become lost, leaving merely the area for it, but without a loop. In such cases there may be left finally nothing of the former pattern but the degeneration triradius, C<sup>d</sup>.

In the case of any pattern, but more especially in the case of this and the next one, the Thenar, there is sometimes some disturbance of the simple parallel course of the lines, not enough to be classed as a definite pattern, but sufficient to have the attention called to it. This is plainly to be considered the last vestige or rudiment of a pattern, and may be indicated by the abbreviation for the pattern, followed by the letter *r*. To call especial attention to it, the whole abbreviation is here enclosed in parentheses, thus (Thr) or (Hr). Parentheses, enclosing the abbreviation, and without the *r*, have the same meaning.

*Thenar pattern; 1st Interdigital Pattern.* These two patterns are extremely likely to occur together in the human hand, but are not necessarily associated, either being possible alone, without trace of the other. In the most usual form they are in the form of two loops, back to back, that is, with the curved ends together and the openings directed away from each other, that of the 1st Interdigital upwards towards the interval between thumb and index, and that of the true Thenar downwards towards the base of the thumb metacarpal (1913, p. 202, fig. 36). Again, both have been found complete, in the form of a whorl rather than a loop, but thus far never simultaneously. The single case of the Thenar whorl was found among the Liberians, and figured (l. c. 1913, p. 202, Fig. 35). The only whorl representing the 1st Interdigital occurs in my collection from Smith College students, and has not been figured.

Eventually, in a complete and satisfactory pattern formula, provision should be made for giving the condition of both of these two associated elements, but thus far it has been found sufficient to indicate the presence of some form of pattern on the Thenar eminence by the letters Th, without further modification.

*Second, Third, and Fourth Interdigital Patterns.* The mere presence of these three patterns is indicated by the digits 2, 3, and 4, respectively, following spaces for the Thenar and Hypothenar Patterns, and in



general no further distinction or description is found necessary, since the patterns, when present, are generally simple loops. In the case of the Fourth Interdigital, and of all patterns lying between triradii C and D, something more has already been found necessary. There is a fundamental difference between the true Fourth Interdigital and a "false" pattern, formed by the bending around of Line C, which forces the lines enclosed to participate in the formation of a loop. Among other characteristics of this "false" pattern is the fact that it is never associated with a triradius, while the true Fourth Interdigital frequently has one; another, and the quickest to recognize, is that the false pattern lies along Line C, and consequently along the inner (radial) side of the space between the two last fingers. In the formulae the digit 4 may be used to represent both forms of patterns, the false one being further designated by a ', and the true one by the simple digit; thus (4, 4'). As a triradius is always represented by an exponent <sup>t</sup>, and as the true pattern quite generally possesses such a character, this is frequently so marked, and then the difference between 4<sup>t</sup> and 4' becomes very apparent. Quite often, too, a given palm shows both sorts of pattern side by side, and this condition appears on the formula as follows, 4', 4<sup>t</sup>. Again, occasionally, where the Line C is short, it runs down into a loop which may be so evenly divided between the Third and Fourth Interdigital as to make it difficult to say which one it is, and in all such doubtful cases, it is best to write the condition, 3+4. Where it is certain that the Fourth element is the false one, it is permissible to add the ' to the 4, making the entire pattern 3+4'.

The above rules may be found sufficient to express all pattern characters except the very unusual, and may be recommended to the reader's use, with the hope that he will be able to not only use this new formulation but complete it as he may need by the aid of easily devised abbreviations based more or less on the one here given.

My actual investigation will be put in the form of the following five Tables, representing, by the method just explained, the pattern condition of the following:

Table XVI	Pattern Formulae of 83 Japanese males (166 palms)
Table XVII	Pattern Formulae of 112 Japanese females (224 palms)
Table XVIII	Pattern Formulae of 50 Chinese males (100 palms)
Table XIX	Pattern Formulae of 50 Chinese females (100 palms)
Table XX	Pattern Formulae of 100 European-American females (200 palms)

The entire list includes the detailed inspection of the palm patterns of 790 human palms, taken quite at random, and including at least two

distinct races. It will thus give opportunity to study the conditions of a very important portion of the body surface, and to test the question as to whether the palmar patterns show ethnological differences or not, and if so, how much.

## 2b PALMAR PATTERNS OF THE JAPANESE

TABLE XVI

Pattern Formulae for 83 Japanese Males (176 palms)

Cat. No.	Lefts				Rights			
( 1)	C	O	Ha	3+4, 4t	Cl	O	Ha	4', 4t
( 2)	Cl	Th	O	4	C	O	O	4
( 3)	C	O	O	4', 4	C	O	O	3
( 4)	P	Th	O	4	P	O	O	4
( 6)	C	O	O	3+4, 4t	C	O	O	3
( 7)	C	O	O	3, 4t	C	O	O	4
(11)	P	O	O	4', 4t	P	O	(Hr)	2, 3, 4t
(12)	P	O	O	3+4, 4t	P	O	O	3+4,
(13)	P	O	O	4	P	O	O	4
(14)	P	O	O	3	Cl	O	Hb	3
(15)	C	O	O	4	C	O	(Hr)	3
(16)	C	O	Ha	4	C	O	Ha	3
(17)	Cd	Th	O	2t, 3	Cd	O	O	2t, 3
(18)	P	O	Ha	3, 4t	P	O	Ha	4
(19)	P	O	Ha	4	P	O	Ha	3t, 4t
(20)	P	Th	Ha	4	P	O	O	4
(21)	P	O	Ha	4'	C	O	O	3
(22)	C	O	O	3	C	O	O	2t, 3
(23)	C	Th	O	4'	C	O	O	3
(24)	C	O	O	4	Cd	O	O	4
(25)	C	O	O	O	C	O	O	O
(26)	C	O	O	3	C	O	O	3
(27)	C	O	O	4	C	O	O	4
(28)	C	O	O	4t	C	O	O	4
(29)	C	O	O	O	C	O	O	3, 4t
(30)	C	O	O	4	C	O	O	4
(31)	C	O	O	4	C	O	O	4
(32)	P	O	O	4	C	O	O	4
(33)	C	O	O	4	C	O	O	4
(34)	C	Th	O	4'	C	O	O	3
(35)	C	O	O	3+4	C	O	O	3
(36)	C	O	O	4'	C	O	O	3 (4t)
(37)	C	O	O	4' (4t)	P	O	O	3
(38)	P	O	O	4	Cd	O	O	4'
(39)	P	O	Ha	4	P	O	Ha	4
(40)	C	O	(Hr)	4', (4t)	C	O	O	3
(41)	C	O	O	3	C	O	O	3
(42)	C	O	O	4', 4	C	O	O	4

TABLE XVI—*Continued*

Cat. No.	Lefts				Rights			
(43)	P	O	O	3+4	P	O	O	3
(44)	C	O	O	O	C	O	O	3
(45)	P	O	(Hr)	4	C	O	(Hr)	4
(46)	C	O	O	4	P	O	O	4'
(47)	C	O	O	4	C	O	Hb	4
(48)	C	O	O	4'	C	O	O	3
(49)	C	O	O	4'	C	Th	O	4'
(50)	C	Th	O	4	C	Th	O	4
(51)	C	O	O	4	P	O	O	4
(52)	C	O	O	3+4	C	O	Hab	3
(53)	C	O	O	4	C	O	O	4
(54)	P	O	(Hr)	4	P	O	O	4
(55)	C	O	O	4	P	O	O	4'
(56)	C	O	O	4', 4t	C	O	O	4
(57)	C	O	O	4	C	O	Ha	2, 4
(58)	C	O	O	4'	P	O	H	3
(59)	C	O	O	3+4	P	O	O	3+4
(60)	P	O	(Hr)	4	P	O	O	4
(61)	P	O	O	4'	C	O	O	3 (4r)
(62)	C	O	Ha	4	C	O	Ha	4
(63)	P	O	Ha	4	P	O	O	4
(64)	C	O	O	4	C	O	O	O
(65)	P	O	O	4'	P	O	O	3'
(66)	C	(Thr)	O	4'	C	O	O	4'
(67)	C	Th	O	4'	C	O	O	4
(68)	P	(Thr)	O	4	C	O	O	4'
(69)	P	O	Ha	4	C	O	O	4
(70)	P	O	O	4	C	O	O	4
(71)	C	O	Ha	4	C	O	O	4
(72)	C	O	O	4', (4t)	C	O	O	4'
(73)	C	O	O	4'	C	O	O	3
(74)	P	Th	O	3	P	Th	O	3
(75)	C	Th	O	3+4	P	Th	O	4'
(76)	P	O	O	3, 4t	C	O	O	3, 4t
(77)	C	Th	O	4	C	Th	O	4
(78)	C	O	Hwb	4', 4t	C	O	Hs	3
(79)	C	O	O	4'	C	O	O	3
(80)	C	O	O	3	C	O	H	3
(81)	C	(Thr)	O	3 (4t)	C	(Thr)	O	(2), 3
(82)	C	Th	O	3, 4t	P	O	(Hr)	4t
(83)	C	O	O	4	C	O	O	4'
(84)	C	O	O	O	C	O	Hb	4t
(85)	C	Th	Ha	3+4', 4t	C	Th	O	(2), 3
(86)	C	Th	O	4	C	O	O	4
(87)*	C	O	O	4'	C	O	O	4

\*The numbers for the Japanese males in my collection are placed in the 1500's, and are completed by adding 1500 to each. They thus run from 1501 to 1587.



TABLE XVII

(Pattern Formulae for 112 Japanese Females (224 palms))

Cat. No.	Lefts				Rights			
(1)	C	O	O	4'	C	O	O	3
(2)	C	O	O	4	C	O	O	4
(3)	C	O	O	4	C	O	Ha	4'
(4)	C	O	O	3+4	C	O	O	3+4
(5)	C	O	Ha	O	C	O	O	O
(6)	C	O	O	4	C	O	O	4
(7)	C	O	O	3	C	O	O	3, 4t
(8)	C	O	O	4	C	O	O	4'
(9)	C	O	Hw	4'	C	O	Ha	3
(10)	C	O	O	4	C	O	O	4
(11)	C	O	O	3+4	C	O	O	3
(12)	C	O	H	4', 4	C	O	H	3
(13)	C	O	O	4	C	O	O	4
(14)	C	O	O	4	C	O	O	4
(15)	C	O	O	4	C	O	H	4'
(16)	C	O	O	4'	C	O	Ha	4'
(17)	C	O	H	4	C	O	O	4
(18)	P	O	O	3	P	O	O	3
(19)	C	O	O	4	C	O	O	4
(20)	P	O	O	4	P	O	O	4
(21)	C	Th	O	4	C	O	O	3
(22)	P	O	Ha	4'	P	O	Ha	4
(23)	C	O	Ha	4	C	O	Ha	4
(24)	C	O	O	4	C	O	H	4
(25)	C	O	O	4	C	O	O	4
(26)	C	O	O	4	C	O	O	4
(27)	C	O	O	4	C	O	O	4
(28)	C	Th	O	4t	C	Th	O	3
(29)	C	O	O	4t	C	O	O	3
(30)	C	O	O	4	C	O	O	O
(31)	C	O	O	4'	C	O	Ha	4'
(32)	C	O	Ha	4	C	O	O	(2), 4t
(33)	C	O	Hb	4	C	O	Hb	4'
(34)	C	O	O	3	C	O	O	3
(35)	C	O	O	4	C	O	O	O
(36)	C	O	O	4	P	O	Ha	3+4
(37)	P	O	Hb	4	P	O	Ha	4
(38)	C	O	O	4	C	O	O	4
(39)	C	O	Ha	4	C	O	Ha	4
(40)	C	O	O	4'	C	O	O	3
(41)	C	O	Hi	4	P	O	Ha	4
(42)	C	O	O	4', 4t	C	O	Ha	O
(43)	C	O	(Hr)	4'	C	O	O	3
(44)	C	O	O	3+4	C	O	O	4

TABLE XVII—*Continued*

Cat. No.	Lefts				Rights			
(45)	C	O	O	4	C	O	O	4
(46)	P	O	O	4t	C	O	O	O
(47)	C	O	Hb	O	C	O	O	4
(48)	C	Th	O	2, 4	C	O	O	4t
(49)	C	O	O	4'	C	O	O	4
(50)	C	O	(Hr)	3 (4t)	C	O	O	3
(51)	P	O	O	3+4	P	O	O	3
(52)	C	O	O	4	C	O	Hl	4'
(53)	C	O	Ha	4t	C	O	Ha	4t
(54)	C	O	Ha	O	C	O	Ha	4
(55)	C	O	O	4'(4t)	C	O	Ha	4t
(56)	C	O	O	4'(4t)	C	O	O	4
(57)	C	O	O	4t	C	O	O	4'
(58)	C	O	O	4	C	O	O	4
(59)	C	O	O	4	C	O	O	4'(4t)
(60)	C	O	O	4	C	O	Hb	4
(61)	C	O	Ha	4	C	O	H	4
(62)	C	O	Hb	4t	C	O	Ha	4', 4t
(63)	C	O	O	4'	C	O	H	3
(64)	C	O	H	4	C	O	H	4
(65)	P	O	O	4'(4t)	C	O	O	4'
(66)	C	O	O	4	C	O	O	3+4
(67)	C	O	Ha	4', 4t	C	O	O	3, 4t
(68)	C	O	O	4	C	O	O	4
(69)	P	O	O	3+4	C	O	Hb	3
(70)	C	O	O	4	C	O	Ha	4
(71)	C	O	O	4'	C	O	O	4
(72)	C	O	O	4	P	O	O	4
(73)	C	O	O	(4t)	C	O	O	O
(74)	C	O	O	4'	C	O	O	4'
(75)	C	O	O	4	C	O	O	4'
(76)	C	O	O	4'	C	O	O	3
(77)	P	O	O	4	C	O	Ha	4
(78)	C	O	(Hr)	4	C	O	H	4
(79)	C	O	O	4', 4t	C	O	O	4
(80)	P	O	Ha	4	P	O	Hac	4
(81)	C	O	Ha	4	P	O	Ha	4
(82)	C	Th	O	3	C	O	O	3
(83)	C	O	O	O	C	O	Hb	O
(84)	C	O	O	4	C	O	O	4
(85)	C	O	O	4	C	O	O	3, 4
(86)	C	O	O	4	C	O	Ha	3
(87)	C	O	O	4' (4t)	C	O	O	3
(88)	C	O	O	4	C	O	O	4
(89)	C	O	O	4'	C	O	O	4

TABLE XVII—*Continued*

Cat. No.	Lefts				Rights			
(90)	C	O	O	3+4, 4t	C	O	O	4
(91)	C	O	O	(4')	C	O	O	(4')
(92)	C	O	O	4	C	O	O	4', 4t
(93)	C	O	O	4	C	O	O	4
(94)	C	Th	O	4', 4t	C	O	O	4
(95)	C	O	Ha	4'	C	O	O	4'
(96)	C	O	H	4	C	O	O	4
(97)	C	O	O	3, 4t	C	O	O	3, 4t
(98)	C	O	O	4	C	O	O	4
(99)	P	O	O	3(4)	C	O	O	3(4)
(100)	C	O	(Hr)	3+4	C	O	Ha	4'
(101)	P	O	O	4	P	O	O	4'
(102)	C	O	O	3	C	O	O	3
(103)	C	O	Hb	3(4t)	C	O	Hb	3
(104)	C	O	(Hr)	3(4t)	C	O	Hb	3
(105)	C	Th	O	4	C	O	O	4'
(106)	P	O	O	4	C	O	Ha	4
(107)	P	O	O	4	P	O	O	3, 4
(108)	C	O	Ha	4	C	O	Hw	4
(109)	C	O	O	3	C	O	O	3
(110)	P	O	O	3+4	P	O	O	4'
(111)	P	O	(Hr)	4	C	O	O	4
(112)*	C	O	Ha	4	C	O	Hs	4

\*The numbers for the Japanese Females in my collection begin with 1601. Hence, they are completed by adding 1600 to each. They thus run from 1601 to 1712.

## 2c PALMER PATTERNS OF THE CHINESE

TABLE XVIII

Pattern Formulae of 50 Chinese Males (100 palms)

(299)	P	O	Ha	4	P	O	Hw	4
(300)	C	O	O	4	C	O	O	3, 4
(301)	C	O	O	4	C	O	O	4
(314)	P	O	Ha	4t	C	O	O	O
(315)	P	O	O	4	P	O	O	3+4
(316)	C	O	O	O	C	O	O	4
(318)	C	Th	Ha	4'	C	O	O	4'
(2)	C	O	O	4	P	O	O	4'
(3)	P	O	O	4', 4t	P	O	O	4', 4t
(4)	P	O	O	4	P	O	Ha	4'
(5)	C	O	O	4	C	O	Ha	4
(6)	C	O	O	4	C	O	O	2, 4
(8)	P	O	O	4	P	O	O	4
(9)	C	O	Ha	4'	C	O	O	4



TABLE XVIII—*Continued*

Catalog Number	Lefts				Rights			
(10)	P	Th	O	4	P	O	O	4
(11)	P	O	O	O	P	O	O	4'
(12)	P	O	O	4t	P	O	O	4
(13)	C	O	O	4'	C	O	O	4'
(14)	C	Th	O	4	C	O	O	4'
(15)	C	O	O	4', 4t	C	O	O	3, 4
(16)	P	O	Ha	3+4, 4t	P	O	Hw	3
(19)	P	O	O	4	C	O	O	3
(20)	C	O	O	4	C	O	O	4
(21)	P	Th	O	4	P	O	O	4
(23)	P	O	O	4', 4t	C	O	O	4
(26)	C	O	O	4	C	O	O	4
(28)	P	Th	O	O	P	O	O	3+4
(31)	C	O	O	4t	C	O	O	3
(32)	C	O	O	4'	C	O	O	4
(33)	C	O	O	4	C	O	O	4
(34)	P	O	O	4	P	O	O	4'
(36)	C	O	O	4	C	O	O	4
(38)	C	O	O	4	C	O	O	4
(40)	C	O	O	4	C	O	O	4
(41)	C	O	O	4	C	O	O	4
(43)	C	O	O	4'	C	O	O	3
(44)	P	O	O	O	P	O	O	O
(45)	C	O	O	O	C	O	O	4', 4
(46)	C	O	O	4t	C	O	O	3
(47)	C	O	O	O	C	O	O	4'
(48)	P	O	Ha	O	C	O	O	O
(50)	C	O	O	O	C	O	O	4'
(51)	C	O	O	4	C	O	O	4
(52)	C	O	O	4	C	O	O	4
(54)	P	O	O	4	P	O	O	O
(55)	C	O	O	3+4, 4t	C	O	O	3+4
(57)	C	O	O	3, 4t	C	Th	O	4
(62)	C	O	O	O	C	O	O	4
(63)	C	O	Ha	4	C	O	Ha	4
(64)*	C	O	O	4	C	O	O	3, 4t

\*The numbers for the Chinese males in my collection, except the first seven, are placed in the 1300's, and are completed by adding 1300 to each.

TABLE XIX  
Pattern Formulae of 50 Chinese Females (100 palms)

Cat. Number	Lefts				Rights			
(4)	P	O	O	4	P	O	O	4
(5)	C	Th	O	4	C	O	O	4
(6)	C	O	O	4'	C	O	O	4
(7)	C	O	Ha	4'	P	O	O	4
(8)	C	Th	O	4	C	Th	O	4
(10)	P	O	O	4'	P	O	O	4'
(11)	P	O	Ha	O	P	O	Ha	4'
(12)	P	Th	O	4'	P	Th	O	3
(13)	C	O	O	4'	C	O	O	4'
(14)	C	O	O	4	C	O	O	4
(15)	C	O	O	O	C	O	O	4'
(16)	P	O	O	4'	P	O	O	3
(17)	C	O	O	4	C	O	O	4
(18)	C	O	O	4	C	O	O	4
(19)	P	O	O	4	C	O	O	4
(21)	C	O	O	4	C	O	O	4
(22)	P	O	O	4	P	O	O	4
(23)	C	O	O	4'	C	O	O	3+4
(24)	C	O	Ha	3, 4t	C	O	Ha	3, 4t
(25)	P	O	Ha	4	P	O	Ha	4
(26)	C	O	O	4	P	O	O	4
(27)	C	O	O	4	C	O	O	4'
(28)	P	O	O	4	P	O	O	4
(29)	C	O	O	4', 4t	C	O	O	4t
(30)	P	O	O	4'	P	O	O	4'
(31)	C	O	O	4	C	O	Hb	4'
(32)	P	O	O	4	P	O	O	4
(33)	C	O	O	4	C	O	O	4
(34)	C	O	Hb	O	C	O	Hb	3+4
(35)	C	O	O	4	C	O	O	4'
(36)	P	O	Hb	4'	P	O	Ha	O
(37)	C	O	O	4	C	O	O	4
(39)	C	O	O	O	C	Th	O	O
(40)	C	Th	O	4	C	O	O	4
(42)	C	O	O	4	C	O	O	4
(43)	C	O	O	O	C	O	O	O
(44)	C	Th	O	4'	C	O	O	4'
(45)	C	Th	O	4', 4t	C	O	O	4
(46)	C	O	O	4	C	O	O	4
(49)	C	O	O	4	C	O	O	4
(50)	C	O	O	4	C	O	O	4
(51)	C	O	O	3+4	C	O	O	3+4
(52)	C	O	O	4'	C	O	O	O

TABLE XIX—*Continued*

Catalog Number	Lefts				Rights			
(53)	C	O	O	4' 4t	C	O	O	3
(54)	C	O	O	4'	C	O	O	4
(55)	C	O	O	4	C	O	O	4'
(56)	C	O	Hb	4t	C	O	O	O
(57)	C	O	O	4	C	O	O	4
(58)	C	O	O	4	C	O	O	4
(59)*	C	O	O	4	C	O	O	4

\*The numbers for the Chinese Females in my collection are placed in the 1400's, and are completed by adding 1400 to each. They thus run from 1401 to 1459.

## 2D PALMAR PATTERNS OF THE EUROPEAN-AMERICANS

TABLE XX

Pattern Formulae of 100 European-American Females (200 palms)

Catalog Number	Lefts				Rights			
(201)	C	O	O	4t	C	O	O	O
(202)	P	O	Hw	4'	P	O	Ha	4'
(203)	C	O	Ha	4'	C	O	Ha	4
(204)	C	O	O	4'	C	O	O	4'
(207)	C	O	Ha	4'	C	O	Ha	3
(208)	C	O	O	4'	C	O	Hb	3
(209)	C	O	Ha	4'	C	O	Ha	3
(210)	C	O	(Hr)	4	C	O	Ha	4
(211)	C	O	(Hr)	(4r)	C	O	(Hr)	3
(212)	C	O	(Hr)	4'	C	O	(Hr)	4'
(213)	C	O	Ha	3	C	O	O	3(4t)
(214)	C	Th	O	4t	C	O	O	2, 3, 4t
(219)	C	O	O	4	C	O	O	4
(221)	C	O	O	3, 4t	C	O	O	3, 4t
(222)	P	O	O	O	P	(Th)	O	4
(223)	P	O	O	4	C	O	O	4
(224)	C	O	O	O	C	O	O	O
(225)	P	O	O	4'	P	O	O	3+4
(226)	C	O	O	4' (4t)	C	O	O	4', 4t
(227)	P	O	(Hr)	3	C	O	O	3
(228)	C	O	Hw	3	C	O	Hs	3
(229)	P	O	O	3	P	O	O	3
(230)	P	O	Ha	4'	P	O	O	4'
(232)	C	O	Ha	2t, 3, (4)	C	O	(Hr)	2, 3
(233)	C	Th	O	4	P	O	O	4'
(234)	C	O	O	O	C	O	O	O
(235)	C	O	O	4	C	O	Ha	4
(236)	C	O	Ha	4', 4	C	O	Ha	3, 4
(237)	C	O	O	4', 4t	C	O	O	3



TABLE XX—Continued

Cat. No.	Lefts				Rights			
(238)	C	O	O	4t	C	O	O	4
(239)	C	O	Ha	O	P	O	Hw	O
(240)	C	O	Ha	3+4	P	O	(Hr)	3
(241)	P	O	O	4	P	O	Ha	4
(242)	C	O	O	3	C	O	O	3
(243)	C	O	O	4'	C	O	Ha	3+4
(245)	C	Th	Ha	4t	P	O	Ha	4'
(247)	P	O	O	4	P	O	O	4
(248)	C	O	O	O	C	O	O	3+4
(249)	C	O	O	2, 3, 4	C	O	O	3
(250)	C	O	O	4	C	O	O	4
(251)	C	(Thr)	O	3	C	O	O	4
(252)	C	O	O	4'	C	O	O	4', 4t
(253)	C	O	O	4'	P	O	O	3
(254)	P	O	O	3	C	O	O	3
(255)	C	O	Ha	4	C	O	Ha	4
(256)	C	O	O	4	C	O	O	3t, 4
(257)	C	O	Ha	3	C	O	Hab	4'
(259)	C	O	(Hr)	4	C	O	Ha	(3t)4
(260)	C	Th	O	4'	C	Th	O	4
(306)	C	Th	O	3t, 4', 4t	C	O	O	3t, 4t
(307)	C	Th	O	O	C	Th	O	O
(313)	C	O	Hb	3+4	C	O	Hc	3, 4
(322)	C	O	Hb	3, 4t	P	O	Ha	3
(323)	P	Th	Hb	3	C	Th	O	3, 4t
(324)	C	O	O	4	C	O	O	4
(325)	C	O	O	4'	C	O	O	4'
(326)	C	O	(Hr)	3	C	O	O	(3)
(387)	P	O	O	4'	P	O	O	4'
(388)	C	O	O	3, 4t	C	Th	O	3, 4t
(389)	C	O	Ha	3	C	O	H	3
(405)	C	O	O	3	C	O	O	3
(406)	C	Th	Ha	3, 4t	C	O	O	3
(407)	C	O	O	O	P	O	O	3
(412)	C	O	O	O	C	O	O	3
(413)	C	O	O	3'	C	O	O	3
(602)	C	O	Ha	3	C	O	Ha	O
(420)	P	O	Hs	3	P	O	Hc	3
(421)	C	O	Ha	O	C	O	Ha	4'
(422)	C	O	O	4	C	O	Ha	4
(423)	P	Th	O	O	C	(Th)	O	4'
(424)	C	O	Ha	4'	C	O	Ha	3
(425)	C	O	O	3	C	O	Ha	3
(426)	C	Th	H	3	P	Th	O	3
(428)	P	O	O	O	P	O	O	3

TABLE XX—Continued

Cat. No.	Lefts				Rights			
(445)	P	O	O	4	P	O	O	4
(448)	P	O	O	4	P	O	O	4
(450)	P	O	O	3	P	O	O	3
(451)	C	O	O	4	C	O	O	4
(453)	P	O	Hb	3	C	O	Hb	4'
(487)	C	Th	O	3t, 4t	C	O	Ha	3
(488)	P	O	Hs	4	C	O	Hs	4
(489)	P	O	O	(4t)	P	O	O	O
(490)	P	Th	Ha	3, 4t	C	O	Ha	3
(491)	C	O	O	4'	C	O	Ha	3
(492)	C	O	O	4'	C	O	Ha	4
(493)	C	O	Hb	3	C	O	Hb	3+4
(494)	C	Th	O	3	P	O	O	3
(495)	P	O	O	3	P	O	O	4'
(496)	C	O	O	3	C	O	O	3
(497)	C	O	Ha	4'	P	O	Ha	3
(498)	C	O	Ha	4'	C	O	Ha	3+4
(499)	C	Th	O	O	C	Th	O	2, 3t
(500)	P	O	O	4	C	O	O	4
(804)	C	O	Ha	4	C	O	Ha	3+4
(805)	P	O	Ha	4'	P	O	Ha	4'
(810)	P	O	O	4'	P	O	O	4
(811)	C	O	O	4	C	O	O	4
(1193)	P	O	Ha	O	P	O	Ha	3
(1194)	C	O	Ha	3(4t)	C	O	Ha	O
(1197)*	P	O	O	4'	P	O	O	O

\*As may be seen by the chance sequence of numbers the individuals here used were taken quite at random from my collection, poor prints being rejected. Thus the first one taken was No. 201, omissions meaning poor prints, until 260 was reached. Beyond this the collection was briefly run through, and selection made of especially clear prints, as they happened to be seen. It is believed that thus a representative set was secured, without any chance of selecting more of a certain type, which might easily be done unconsciously, following some pattern that might seem interesting. For instance, the frequency of the Hypothenar could easily, although involuntarily, have been increased if the one selecting the hundred prints had a special interest in that feature. But in the method of selection used it is believed that the greater frequency of this pattern is an actual condition, not in any way dependent on prejudice.

#### 2c A DISCUSSION OF RACIAL DIFFERENCES IN THE PALMAR PATTERNS

In looking over the above formulae (Tables XVI-XX), which record the pattern condition of nearly 800 human palms of at least two distinct races, certain general conditions and certain distinct racial differences

are seen at once. Probably the most conspicuous of these, and the one which first catches the eye, is the much greater frequency of occurrence of the *Hypothenar pattern* in the "White" over that seen in the "Yellow" race, and this appearance is borne out by a careful count. This is as follows:

TABLE XXI

Occurrence of the Hypothenar Pattern in Caucasians and Mongolians

No. of Palms	Race and Sex	Actual Number			Percent		
		Left	Right	Both	Left	Right	Both
166	Japanese males	13	14	27	7.8%	8.4%	16.2%
224	Japanese females	25	38	63	11.6	17.0	28.6
100	Chinese males	7	5	12	7.0	5.0	12.0
100	Chinese females	7	6	13	7.0	6.0	13.0
200	European-American females	34	38	72	17.0	19.0	36.0

In the case of the Chinese the closeness of the results in males and females suggests, as we naturally believe, that there is no sex difference in the pattern peculiarities, and that it would be best to put the two together and eliminate the sex factor. The Japanese, on the other hand, show a considerable difference in the males and females, but this is probably due to chance, or to the use of a small number of individuals, and for the sake of comparison these also should be united. This obliteration of the sexes from the above table gives the occurrence of the Hypothenar Pattern, without regard to sex, in the three peoples considered as follows:

TABLE XXII

Occurrence of the Hypothenar Pattern in Caucasians and Mongolians (sexes not separated)

No. of Palms	Race	Actual Number			Percent		
		Lefts	Rights	Both	Lefts	Rights	Both
390	Japanese	38	52	90	9.7%	13.3%	23.0%
200	Chinese	14	11	25	7.0	5.5	12.5
200	European-American	34	38	72	17.0	19.0	36.0

These figures, especially the final percentile ones, definitely corroborate the impression produced by the first glance at our tables,



namely, that the occurrence of an Hypothenar pattern is much greater in European-Americans than in the two representatives of the "Mongolians" here considered; that in the Chinese *the percentile occurrence of this pattern is but one-third that of the European-Americans*, a profound difference, and one worthy of consideration as an ethnological criterion. On the other hand *the occurrence of this same pattern among the Japanese is two-thirds that of the European-Americans, and almost twice that of their neighbors, the Chinese*. This would certainly strengthen the belief that the Japanese are of a strain different from the Chinese, and tends to suggest the strong admixture of a "White" element, perhaps from Korea, or from the aboriginal Ainos, or both. Of course nothing as conclusive or as definite as that could be absolutely asserted, but the conditions in this regard are certainly confirmatory.

A *Thenar pattern*, even when we consider as such either the true Thenar, the first Interdigital, or, what most generally happens, a combination of the two, is, in all the peoples here considered, a rare pattern. Counted and treated like the Hypothenar, its occurrence is as follows:

TABLE XXIII

Occurrence of the Thenar Pattern (Thenar + 1st. Interdigital) in the peoples here considered.

No. of Palms	Race and Sex	Actual number			Percent		
		Left	Right	Both	Left	Right	Both
166	Japanese males	14	6	20	8.4%	3.6%	12.0%
224	Japanese females	6	1	7	2.6	0.4	3.0
100	Chinese males	5	1	6	5.0	1.0	6.0
100	Chinese females	6	3	9	6.0	3.0	9.0
200	European-American	14	6	20	7.0	3.0	10.0

With the sexes combined, as in the previous case, we have the following simplified table:

TABLE XXIV

Occurrence of the Thenar pattern (Thenar + 1st Interdigital) in the peoples here considered.

No. of Palms	Race	Actual Number			Percent		
		Left	Right	Both	Left	Right	Both
390	Japanese	20	7	27	5.1%	1.8%	6.9%
200	Chinese	11	4	15	5.5	2.0	7.5
200	European-American	14	6	20	7.0	3.0	10.0

The Thenar occurrence is not very different in the "Caucasian" and the "Mongolian" races, and the two representatives of the latter are about the same. That this pattern *may* form a definite racial criterion has already been shown in the case of the Central American Maya Indians from Yucatan, in which, although based upon a very insufficient number of cases, a Thenar pattern is almost universal. Here the difference in occurrence between 7% for the Mongolians, and 10% for the European-Americans may prove constant, and definite, but with the small number here used, and the rarity of the pattern at best, this does not seem likely. It may be said, however, that in all the peoples studied here the Thenar pattern is rather rare (7-10%).

The Interdigital series may next be considered, the First of which, not distinguished here from the true Thenar, has already received some treatment.

This brings us to the Second Interdigital pattern, found at the base of the forefinger, or rather below the interval between this and the middle finger. In all three peoples considered here it is extremely rare, and, so far as we have thus far ascertained, has no racial significance.

In the cases collected here this pattern is much more frequent in Japanese males, occurring in the following: No. 11, right; 17, left; 17, right; 22, right; 57, right; that is, five cases in 166 separate palms. There are also several cases where a space for such a pattern is indicated, but where the lines form no definite loop, a rudiment or vestige.

In 224 Japanese females, a definite pattern occurs here but once, in No. 48, left, but, as in the males, there are several cases of a pattern vestige.

In all the Chinese represented, including 100 male and 100 female palms, there is but a single case, No. 6 right, of the male series. Here, as in other things, the Chinese represent an extreme effacement of the earlier conditions.

In the 100 European-American females (200 separate palms) a Second Interdigital pattern occurs 5 times, as follows: No. 214, right; 232, left; 232, right; 249, left; 499, right.

The actual number is the same as seen in a somewhat smaller number of Japanese males, but a slightly larger number of Japanese females showed only a single pattern, so that, on the whole, the European-Americans probably show a larger percentage of this pattern than do either of the Oriental nations studied, about 2.5%.

The condition of the two remaining Interdigital patterns, the Third and Fourth, is shown by the four following Tables, taken from

Tables XVI-XX. As explained already, in these formulae, 3 indicates any form of the Third pattern, the one lying between triradii *b* and *c*, or between the middle and ring fingers. Probably this is always a "true" pattern, and the two adjacent triradii, *b* and *c*, belong to it. Occasionally the lines of this space, uniting with a set of lines between triradii *c* and *d*, form a U-shaped loop which curves around the free end of a short Line C, and this condition, probably not a true pattern, is indicated by the expression 3+4. A Fourth Interdigital pattern, between triradii *c* and *d*, is expressed by the symbol 4, when a "true" pattern, and by 4', when evidently produced by the curving around of Line C. A 4, with an exponent letter *t*, signifies, not only a true pattern, but one with a second (lower) triradius, aside from the usual triradius *d*.

The conditions of the Third and Fourth Interdigital patterns, as shown by the formulae, are as follows (Tables XXV, XXVa, XXVI, and XXVIa).

TABLE XXV

Occurrence and Condition of the Third and Fourth Interdigital patterns in Japanese, Chinese, and European-Americans. *Actual numbers.*

No. of Palms	Race and Sex	3	3+4	4	4'	4t
166	Japanese males	45	11	70	33	19
224	Japanese females	40	11	110	42	21
100	Chinese males	9	5	53	19	11
100	Chinese females	5	4	54	25	7
200	European-American females	77	8	49	43	19

TABLE XXV a

Same as before, but with the numbers *percentile* rather than *actual*. In this, all the results may be directly compared, without reference to the number of cases taken in each case.

No. of Palms	Race and Sex	3	3+4	4	4'	4t
166	Japanese males	27%	6.6%	45.0%	20.0%	11.4%
224	Japanese females	17.8	4.9	49.1	18.7	9.4
100	Chinese males	9.0	5.0	53.0	19.0	11.0
100	Chinese females	5.0	4.0	54.0	25.0	7.0
200	European-American females	38.5	4.0	24.5	21.5	9.5



As would be expected, these figures for the most part do not show appreciable sex differences, as may be most easily seen in the case of the Chinese, with 100 palms each for males and females. Here we have, for instance 5.0 and 4.0; 53.0 and 54.0; and 13.0 and 10.0, slight differences which might readily be equalized, if we had a larger number of instances. Perhaps, however, the 9.0 and 5.0 of the Third Interdigital pattern may be a little significant, especially when we compare it with the equally unlike figures of 27.0 and 17.8 for the Japanese, the difference being in the same direction. If we were ready or able to give a Lamarckian explanation for palmar configuration in general, we might find here some hint at a diversity of occupation in the two sexes, but this would carry us too far. Since, in most cases the differences are but slight in the two sexes, it would be better to put the two together, as we have in other cases, and amalgamate the male and female Japanese, also the male and female Chinese, and present for the study of racial differences a larger number of cases, without sex distinction. This leads us to the next two Tables, XXVI and XXVIa.

TABLE XXVI

Occurrence and Condition of the Third and Fourth Interdigital patterns in Japanese, Chinese, and European-Americans, without the sex distinction. *Actual numbers.*

No. of Palms	Race	3	3+4	4	4 <sup>1</sup>	4t
390	Japanese	85	22	180	75	40
200	Chinese	14	9	107	44	18
200	European-Americans	77	8	49	43	19

TABLE XXVI a

Same as the above, but with the numbers *percentile*, rather than *actual*. All the results may hence be directly compared.

No. of Palms	Race	3	3+4	4	4 <sup>1</sup>	4t
390	Japanese	21.8%	5.6%	46.0%	19.2%	10.25%
200	Chinese	7.0	4.5	53.5	22.0	9.0
200	European-American	38.5	4.0	24.5	21.5	9.5

From these four Tables the following conclusions may be derived. *Third Interdigital pattern.* This pattern is much more frequent in European-Americans than in the Chinese, the proportions being respect-

ively 38.5 and 7.0, far too great a difference to be due to chance. Definitely formulated, as perhaps the greatest racial difference between the two, it may now be stated *that the Third Interdigital pattern is more than five times as common in European-Americans as in the Chinese, the proportions being respectively 38.5 and 7.0%.* Here again the Japanese, with the proportion of 21.8%, stand midway between the two, and suggest, as in several other cases, a plentiful admixture of Caucasian blood. *Fourth Interdigital pattern.* A plain Fourth Interdigital pattern, without triradius, and not a "false" one, formed by a loop of Line C, is much more common in the Chinese, the proportion of this condition being to that in the European-Americans as 53.5 to 24.5%, more than twice as frequent. As we have already been led to expect, the Japanese, with 46.0%, come in between the two. The percentage of occurrence of the other forms of this pattern is about the same for all; a false pattern (4') being 19.2, 22.0, and 21.5 in the three, and a pattern with a triradius, 10.25, 9.0 and 9.5 respectively.

## II SOLES

### 1. SOLE-FORMULAE OF JAPANESE, CHINESE, AND EUROPEAN-AMERICANS

Perhaps the most striking difference between the soles of the Japanese and Chinese on the one hand, and those of other races lies in the extreme degree of effacement of patterns shown in the former, and consequently the monotony of a set of the soles of these people, as compared with Europeans.

The five Tables immediately following present the sole conditions in the races in question, formulated in accordance with the scheme published in "Personal Identification." (Badger, Boston, 1918) and although this scheme is quite inadequate for careful morphological work, and was devised simply for the use of the Police in identifying individuals, it will be found to work fairly well in demonstrating the characteristics here considered. These Tables are as follows: Table XXVII—Sole formulae of 85 Japanese males; T. XXVIII—Sole formulae of 112 Japanese females; T. XXIX—Sole formulae of 25 Chinese males; T. XXX—Sole formulae of 66 Chinese females; T. XXXI—Sole formulae of 100 European-American females (Smith College students).

To these should be added another set of Smith College students, one published three years ago in "Personal Identification," pp. 179-181, and formulated by the same system. The individuals who constitute the two sets are different, and thus the two represent 200 European-American females, sufficient for a good comparison with the Oriental peoples studied here.

TABLE XXVII

Sole Formulae of 85 Japanese Males

(Doshisha; Kyoto, 1920)

[Formulae after Wilder and Wentworth, p. 175]

1	A41	A41	44	B5D	B5D
2	A17D	A5D	45	A1	A1
3	A5D	A5D	46	A5D	W5D
4	A5D	W5D	47	O1	W1
5	B5D	O5D	48	O5	O17
6	W1	W1	49	A5D	A5D
7	W5D	W5D	50	A5D	A5D
8	A1	A1	51	W5D	W5D
9	W5D	W5D	52	A13	A13
10	B2	B1	53	A1	A1
11	A2D	A6Dd	54	B5D	B5D
12	O1	B1	55	B5D	W5D
13	A1	A1	56	A5D	A5D
14	A1	A1	57	A37D	A38Dd
15	B1	O1	58	A1	A1
16	A1	A1	59	A1	B17
17	W5D	A5D	60	A1	A1
18	W41	W37	61	A5D	A5
19	W1	W1	62	B5D	B5D
20	A5D	A5D	63	A1	A1
21	A1	A1	64	O5	O5
22	B5D	W5D	65	B17	B17
23	O5	O5	66	A5D	A5D
24	A1	A1	67	W1	W1
25	B1	B1	68	A5D	A5D
26	W5D	W5D	69	B5D	B5D
27	A5D	A1	70	O2	B17
28	W5D	W5D	71	W5D	W5D
29	A6Dd	A6Dd	72	O1	O5D
30	W5D	A1	73	A1	A21
31	A5D	A5D	74	W21	W1
32	B1	B1	75	A1	A1
33	A2D	A2D	76	A1	W5D
34	B5D	B5D	77	B1	B1
35	B5	B5	78	W5D	W5D
36	A5D	W5D	79	W1	W1
37	A1	A3	80	A1	A1
38	A5	A5	81	A5D	O6
39	W5D	W6	82	A1	A5D
40	B1	B1	83	W5D	W5D
41	A5D	A5D	84	A1	B1
42	W46	W48	85	A5D	A5D
43	W5D	W5D			



TABLE XXVIII

Sole Formulae of 112 Japanese Females

(Doshisha, Kyoto, 1921)

(Formulae after Wilder and Wentworth, p. 175)

1	W1	W1	41	A1	A1
2	B5D	B5Dr	42	A1	A1
3	W1r	W1	43	A1	A1r
4	A5D	A5D	44	A1r	A5D
5	W5Dr	W5D	45	W1	W1
6	B1	W1	46	O5	O13
7	W1	W1	47	W41	W9
	(Calcar loop on right)		48	W5D	W5D
8	W5D	W5D	49	A17	A17
9	B1	B1	50	W1	W1
10	A5Dr	A5D			
11	O17	A5	51	A5Dr	A1r
12	W1r	W1	52	O21r	O21
13	A1	A1	53	W5D	W6Dd
14	B1r	A1r	54	B5D	A5D
15	A1r	A1r	55	W1	W1
16	A1	A1	56	A5D	A1
17	A21d	A17D	57	A1r	A1r
18	B5D	B5D	58	A1	A5D
19	A1	A5D	59	B1	B1
20	A5Dr	A1r	60	A1	A1
21	A21Dd	A21Ddr	61	O5D	A5D
22	B1	B5D	62	B1	B5D
23	W1	W1r	63	W1	W1
24	A1r	A1r	64	A5Dr	A5Dr
25	A5D	A5D	65	A1	A1
26	W1	W1	66	O5	B5D
27	A21Dd	A5D	67	A1	A1
28	B5D	B5D	68	W1	A1
29	A21Dd	A21Dd	69	A1r	A1r
30	B5Dr	B5D	70	B5D	A5Dr
31	A5D	A6	71	A1	A1
32	A6Dr	A5D	72	W5D	B5D
33	A1	A1	73	A5D	A5D
34	B5r	W1	74	A5D	A5D
35	A1	A1	75	W5D	W5D
36	B5D	A5D	76	A1	A1
37	A1Dr	A1Dr	77	A1	W1
38	A1r	A5D	78	A1r	A1r
39	A5D	A1	79	W1r	W5Dr
40	A1	A1	80	O1	A1

TABLE XXVIII—*Continued*

81	A1	A1	97	O29	A13
82	W21Dd	W5Dr	98	A1	W1r
83	O61	O29	99	A5Dr	A5D
84	W29Dr	O5D	100	W5D	A5D
85	W37D	O5D			
86	A1	A1	101	A1	A1
87	A1	A1	102	W22Ddd	A5D
88	B1	B1	103	A5Dr	A21
89	W5D	W1	104	O45r	O13r
90	A5D	A21D	105	A5Dr	A1r
			106	W1	W1
91	A1	A1	107	W37	W6
92	W1	O5D	108	A1	W5D
93	W5D	W5Dr	109	A17	A5D
94	B1	B17r	110	B5D	O5Dr
95	A1	W1	111	A5D	A5D
96	A5D	A5D	112	A1	A17

TABLE XXIX

Sole Formulae of 25 Chinese Males

(Formulae after Wilder and Wentworth, p. 175)

300	A1	W1	1327	A21Dd	W17D
301	A1	B1	1340	A5D	A9D
302	A1	A5D	1341	A5	A1
1301	W5D	W5D	1342	W5D	W37D
1302	O5	O5	1344	O11Dd	O11Dd
1303	O5	A1	1345	A1	A1
1304	W5D	W5D	1346	O5	O5
1305	A1	A1	1348	B5D	B5D
1306	B33	B33	1349	W5D	A5D
1321	A1	A1	1356	W5D	W5D
1322	A1	A1	1364	W5D	W5D
1324	A37D	W5D	1365	W21Dd	W5D
1325	A33D	A5D			

TABLE XXX

Sole Formulae of 66 Chinese Females.  
(Formulae after Wilder and Wentworth, p. 175)

1	A1	A1	23	A1	A1	45	W21Dd	W5D
2	A1	A1	24	A1	A1	46	A1	A5D
3	A25Dd	A9Dd	25	B5D	W5D	47	A21Dd	A21Dd
4	W5D	W5D	26	W5D	B13D	48	B37D	B5D
5	A1	A5D	27	A1	A1	49	A1	A1
6	B5D	B5D	28	A5D	A1	50	A1	A1
7	A1	A1	29	B5D	A1	51	B1	B1
8	W5D	W5D	30	A5D	A5D	52	A5D	A5D
9	W1	A1	31	A5D	A5D	53	W5D	W17D
10	W5D	W5D	32	W5D	A21Dd	54	W1	W1
11	B5D	W5D	33	W5D	W5D	55	A5D	A5D
12	A1	A5D	34	A1	A1	56	O5D	O5D
13	W1	A1	35	W1	W5D	57	A1	A1
14	W1	A1	36	W18D	W1	58	A1	A1
15	W5	W5D	37	A5D	A5D	59	A1	A17D
16	A1	A5	38	A5D	A5D	60	A1	A1
17	A1	A1	39	A1	W5D	61	A5D	A5D
18	W1	W1	40	A1	A1	62	W6Dd	A6Dd
19	A5D	A5D	41	A1	A1	63	A1	A1
20	A1	A1	42	A1	A1	64	A21Dd	W5D
21	W5D	W5D	43	W1	A1	65	A1	A1
22	A1	A1	44	B5D	A5D	66	A1	A1

TABLE XXXI

Sole Formulae of 100 Smith College Students.  
(Second Series 1921)

1	A6Dd	A2d	17	A1	A1
2	W5D	W5D	18	A5D	A5D
3	A6Dd	A6Dd	19	W5D	A5D
4	W5D	A5D	20	W37	W37
5	A5D	A5D			
6	W43	W41	21	W1	A1
7	W45	W47	22	A1	A1
8	A6dd	A6dd	23	A1	A1
9	W1	W1	24	A6Dd	A6Dd
10	W37D	W37D	25	A5D	A5D
			26	A2	A6dd
11	A53D	A53D	27	A6D	A2
12	A33	A1	28	W1	W1
13	A17d	A17D	29	B41	B46
14	A1	A1	30	A5D	A5D
15	A5D	W38			
16	A5D	A5D	31	A6	A6



TABLE XXXI—*Continued*

32	A1	A5D	67	W5D	W15D
33	W1	W1	68	A17	A2
34	A37D	B6dd	69	W34d	W38dd
35	W37D	W45D	70	W5D	O5
36	A5D	A9			
37	B37D	W5D	71	A45D	A45D
38	W45d	W5D	72	W1	W13D
39	B25D	B5D	73	W1	A5D
40	O61	O13	74	W21dd	A5D
			75	W1	W5D
41	A5D	A5D	76	A1	A1
42	W17D	W49D	77	A6Dd	A6Dd
43	W6D	W5D	78	A1	A37D
44	A35D	A33	79	A1	A13
45	O37	O5	80	A6DD	A6DD
46	W5D	A5D			
47	W5D	A5D	81	A5D	A5D
48	W37D	W38D	82	W46D	O48D
49	A2d	A2d	83	B5D	B5D
50	B37d	B5D	84	B5D	A5D
51	A5D	A5D	85	W5D	W5D
52	A29Dd	A29Dd	86	A5D	W6
53	A5D	A5D	87	A1	A5D
54	W5D	A5D	88	A5D	AB5D
55	W5D	W5D	89	A5D	A2D
56	B15	B13	90	A5D	A37d
57	W5D	A6			
58	A2	A6	91	A5D	A5D
59	A1	W5D	92	A1	A1
60	A21DD	A5D	93	W63	W29
			94	A33	A33
61	W1	W1	95	A5D	A6D
62	W37	W37	96	B45D	W37D
63	B45D	B15D	97	A1	A1
64	A5D	A33	98	W1	B1
65	A17	A17	99	W5D	B5D
66	A5D	W5D	100	W1	W2

## 2 SEPARATE PLANTAR REGIONS IN DETAIL

## 2a THE REGION OF THE BALL OF THE FOOT

This includes the entire semi-detached distal portion of a print from the base of the toes to the middle of the sole at its narrowest part. In a foot with exceptionally high instep this portion, in a tread-area print, is often entirely separated from the proximal, or heel, half. Morphologically, this region shows four separate patterns, the vestiges of the same num-

ber of walking pads, constant and well-developed in typical walking mammals with five digits, the *four interdigital pads*. In human feet these may be represented, when in fairly primitive condition, by four whorl patterns in a single row across the foot, or may show a greater or less degree of modification or breaking up of the original whorls in any or all of the four. In the somewhat artificial formulae in use here, the condition of the first, the *hallucal* or *ball pattern*, is indicated by certain letters, A, B, O, or W, while the condition of the others, in all possible combinations, is indicated by a number, from 1 to 64. The number 1 indicates



FIGURE 1

Sole tracing of Chinese female; Coll. No. 1441.

This illustrates the common type formulated as A with an Hallucal pattern of the A type, and with the plantar areas featureless.

the simplest of all conditions with no vestige remaining of any of the three; the highest number 64 signifies that all three are whorls; in general the lower numbers are simpler and with more loss of original conditions, while the higher the number the more patterns there are left, and the more primitive the general condition.

Fig. 1, a common condition met with in the feet of all human races, so far as known, is formulated by the number 1, following the letter for the hallucal pattern present, and is thus either A<sub>1</sub>, B<sub>1</sub>, O<sub>1</sub>, or W<sub>1</sub>. So far as known there has been known one case in the entire world thus far with a C pattern for the hallucal one, and may thus be considered as negligible. The combination with A, that is, the formula A<sub>1</sub>, is the most common, then come in order W<sub>1</sub>, B<sub>1</sub>, and O<sub>1</sub>, in the last the hallucal pattern is reduced to a single large triradius, but may easily be derived from one of the other forms. If we disregard the hallucal pattern, altogether, and make no distinction between the different types, we may use the generalized formula X<sub>1</sub>, in which the X represents any form of hallucal pattern, and the 1 a reduction of all traces of the other three patterns.

TABLE XXXII

The distribution of the X<sub>1</sub> type of sole among Japanese, Chinese, and European-Americans (Smith College students).

Table	Race, Sex and Number of Individuals	Formulae	Actual Number	Percentage
XXVII	85 Japanese males (170 separate soles)	A <sub>1</sub>	34	
		B <sub>1</sub>	12	
		O <sub>1</sub>	4	
		W <sub>1</sub>	10	
		X <sub>1</sub>	60	35.3%
XXVIII	112 Japanese females (224 separate soles)	A <sub>1</sub>	65	
		B <sub>1</sub>	11	
		O <sub>1</sub>	1	
		W <sub>1</sub>	31	
		X <sub>1</sub>	108	48.2%
XXIX	25 Chinese males (50 separate soles)	A <sub>1</sub>	13	
		B <sub>1</sub>	1	
		O <sub>1</sub>	0	
		W <sub>1</sub>	1	
		X <sub>1</sub>	15	30.0%



TABLE XXXII—*Continued*

Table	Race, Sex and Number of Individuals	Formulae	Actual Number	Percent- age
XXX	66 Chinese females (132 separate soles)	A <sub>1</sub>	54	
		B <sub>1</sub>	2	
		O <sub>1</sub>	0	
		W <sub>1</sub>	10	
		X <sub>1</sub>	66	50.0%
Table from Pers. Ident. pp. 179-181	100 European-Americans (200 separate soles)	A <sub>1</sub>	38	
		B <sub>1</sub>	2	
		O <sub>1</sub>	1	
		W <sub>1</sub>	24	
		X <sub>1</sub>	65	32.5%
XXXI	100 European-Americans (Smith College students) (200 separate soles)	A <sub>1</sub>	21	
		B <sub>1</sub>	1	
		O <sub>1</sub>	0	
		W <sub>1</sub>	14	
		X <sub>1</sub>	36	18.0%

This simplest type of sole print, in which all the features of the ball of the foot have been lost except the hallucal, is always a common type, but in general is far more frequent among the Chinese and Japanese than among the members of the European race. We may compare such percentages as 48.2 for Japanese females, and 50 for Chinese females, with the 32.5 for the first set of European females and with 18 for the second. Our tables show that this type is not so frequent among Mongolian males, but it is improbable that there is here any real sexual difference, and it is far more likely that the numbers of individuals were too small to get reliable results. If we add together the results for both sexes of the Chinese we get  $66+15=81$  cases in  $132+50=182$  separate soles, or 44.5%. The Japanese, treated in the same way, give  $108+60=168$  out of  $224+170=394$  separate soles, or 42.6%. For comparison with these we may combine the results from the two sets of Smith College students, and we get out of 400 soles only 101 of this type, or a trifle more than 25%.

Another very common type among the Chinese and Japanese is one in which the ball area is almost as simple as the former, but contains a single broad, U-figure, spread out over a large part of the surface, and is almost always accompanied by a single large "lower triradius," which

runs across the sole, and separates the ball from the rest of the foot. This type is represented in Fig. 2, accompanied by the W type of hallucal pattern, but, as in the former case, any one of the four hallucal patterns may accompany it, the A type being the most usual. In the sim-

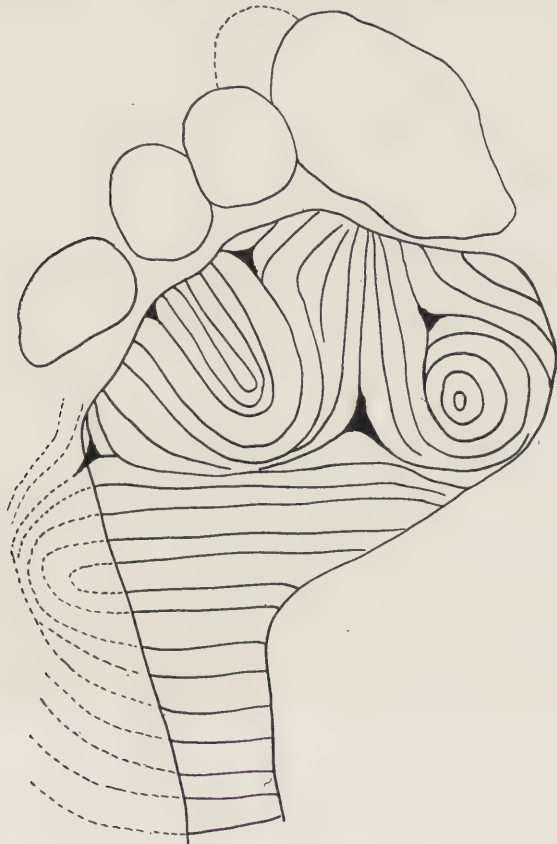


FIGURE 2

Sole tracing of Chinese female; Coll. No. 1426.

This illustrates the type formulated as W5D, which has an hallucal pattern of the Whorl type, and which shows a U-loop in the second plantar area; a lower triradius is also usual, as in this case.

plified notation of *Personal Identification* this type is represented by the letter representing the hallucal pattern present, followed by the number 5, and then by a D for the lower triradius, when present also. The distribution of this type among the races, expressed in the same way as was done with the  $X_1$  type, is thus shown (Type X5D).

TABLE XXXIII

The distribution of the X5D type of sole among the Japanese, Chinese, and European-Americans (Smith College students).\*

Table	Race, Sex and Number of Individuals	Formulae	Actual Number	Percent- age
XXVII	85 Japanese males (170 separate soles)	A5D	32	
		B5D	15	
		O5D	7	
		W5D	27	
		—	—	
		X5D	81	62.3%
XXVIII	112 Japanese females (224 separate soles)	A5D	39	
		B5D	17	
		O5D	7	
		W5D	18	
		—	—	
		X5D	81	36.1%
XXIX	25 Chinese males (50 separate soles)	A5D	5	
		B5D	2	
		O5D	5	
		W5D	12	
		—	—	
		X5D	24	48.0%
XXX	66 Chinese females (132 separate soles)	A5D	22	
		B5D	7	
		O5D	2	
		W5D	21	
		—	—	
		X5D	52	39.3%
Table taken from Pers. Ident. pp. 179-181; 100 European-Americans (Smith College students)		A5D	36	
		B5D	4	
		O5D	1	
		W5D	9	
		—	—	
		X5D	50	25.0%
XXXI	100 European-Americans (Smith College students)	A5D	41	
		B5D	6	
		O5D	2	
		W5D	21	
		—	—	
		X5D	70	35.0%

\* This type (X5) may occur without the accompaniment of the lower triradius (D), and is then formulated as A5, B5, etc., instead of A5D, B5D, and so on. In the above table a few such cases, without the D, are included.



Here also, as in the type  $X_1$ , there is in general a much greater occurrence of this type in the Chinese and Japanese than in the Europeans. Thus the 48% of Chinese males, and the 62.3% of Japanese males, certainly show up in striking fashion against the 25% and 35% of the two Smith College sets, yet it must be conceded that there is but little difference between the Japanese females, with 36.1%, and the second European set, Smith College, Series II, with 35%. Probably, however, in all the sets we are dealing with too few individuals to get accurate results, and probably the higher percentages in the males is also accidental. If, now, we add together the male and female of each Oriental race, and amalgamate also both of the Smith College series, the results are much more striking, thus:

TABLE XXXIV

Summary of the final Results from the preceding Table. Occurrence of the type  $X_5D$ .

91	Chinese (182 soles)	76 cases	41.7%
197	Japanese (394 soles)	162 cases	41.2%
200	Smith College students (400 soles)	120 cases	30%

This shows a considerable disparity in the type  $X_5D$ , yet not so great a one as was seen in type  $X_1$ . If, now, we put the two together, and get the total percentage of occurrence in the races in question of the two types,  $X_1$  and  $X_5D$ , the two simplest and most highly specialized that occur, we find very definitely what has been apparent from the first, that *in the occurrence of these two highly specialized types the Chinese and Japanese greatly surpass the Europeans, that in the latter there is a far greater occurrence of more primitive types*, and finally, as a corollary of the rest, that *in Europeans there occur many more separate formulae, while in the Chinese and Japanese the sole patterns are much more monotonous*. Incidentally it happens that for purposes of personal identification the soles of Europeans have much greater possibilities. These are the percentages, using both types together:

TABLE XXXV

Occurrence of the two simplest, i. e., most human, types among Mongolians and Europeans.

Race	Type $X_1$	Type $X_5D$	Both Together
Chinese	44.5%	41.7%	86.2%
Japanese	42.6%	41.2%	83.8%
Europeans	25.0%	30.0	55.0%

This, then, is the final summary of all the cases that have come under our consideration, 400 separate European soles, and 576 Mongolian ones, seemingly enough from which to draw fairly definite conclusions. The summaries of Chinese and Japanese, 83.8 and 86.2, are nearly enough alike to be considered the same, while the results from Europeans are radically different, 55. From this we are now prepared to assert that an essential difference in the foot patterns of the Mongolians and Europeans consists in the relative occurrence of the two simplest types,  $X_1$  and  $X5D$ , and as in these is seen the goal of human achievement in this particular, the former race has nearly doubled the latter in its degree of success. The corollary from this is the correspondingly greater variability in the European race, and the much larger proportion of characters that have survived from the lower animals, making the Europeans more primitive.

To set forth this corollary more completely it is only necessary to give the list of formulae, other than the two just treated, that occur in the soles before us. The actual number of the two races is not so very different, and, with the larger number, the advantage lies on the side of the Mongolians.

In the 400 separate soles of the Smith College students, after the elimination of all cases of  $X_1$  and  $X5$ , the list is as follows, also generalizing and leaving differences of hallucal pattern out of account:

TABLE XXXVI  
Occurrence of other formulae among European-Americans

X 2 = 9	X 21 = 2	X 37 = 15	X 47 = 1
X 6 = 21	X 25 = 1	X 38 = 3	X 48 = 1
X 9 = 1	X 29 = 3	X 41 = 2	X 49 = 1
X 13 = 4	X 33 = 5	X 43 = 1	X 53 = 2
X 15 = 3	X 34 = 1	X 45 = 7	X 61 = 1
X 17 = 6	X 35 = 1	X 46 = 2	X 63 = 1

The formulation, as elsewhere, is that of *Personal Identification* p. 175, and is so constructed that, in general, the higher the number the more primitive and complex the features designated.

In contrast to this showing among the European race, we find, among the Mongolians given above, the following:

TABLE XXXVII  
Occurrence of other formulae among Orientals

X 2 = 5	X 13 = 6	X 25 = 1	X 41 = 4
X 3 = 1	X 17 = 16	X 29 = 3	X 45 = 1
X 6 = 11	X 18 = 1	X 33 = 3	X 46 = 1
X 9 = 3	X 21 = 20	X 37 = 7	X 48 = 1
X 11 = 2	X 22 = 1	X 38 = 1	X 61 = 1

That is, the individuals of European stock show, aside from the two commonest formulae, X<sub>1</sub> and X5D, 24 different generalized formulae, or those in which the hallucal patterns are not regarded, while in the Chinese and Japanese, a somewhat larger number of individuals, there are only 20. Taking the Chinese alone, there are but 10, the highest in the list, that is, the most primitive, being X 37. All in this Oriental list above this point are found only in the Japanese, at least so far as concerns our own collection.

This difference, which shows not only the difference between Europeans and Orientals, but also that between Chinese and Japanese, is best brought out by the actual formulae, as they appear in the two peoples.

TABLE XXXVIII  
Comparison of Chinese and Japanese in regard to other formulae

<i>Chinese</i>	<i>Japanese</i>
X 6 = 2	X 2 = 5
X 9 = 2	X 3 = 1
X 11 = 2	X 6 = 9
X 13 = 1	X 9 = 1
X 17 = 3	X 13 = 5
X 18 = 1	X 17 = 13
X 21 = 7	X 21 = 13
X 25 = 1	X 22 = 1
X 33 = 3	X 29 = 3
X 37 = 3	X 37 = 4
—	X 38 = 1
25	X 41 = 4
	X 45 = 1
	X 46 = 1
	X 48 = 1
	X 61 = 1
	—
	64



Thus, among 132 Chinese soles, there are but 25 (18.1%) with a formula other than  $X_1$  or  $X5D$ , and among 394 Japanese there are 64 (16.2%); but these atypical Chinese all belong towards the lower end of the list of possible formulae, and are hence rather simplified, while the Japanese run along almost the entire list. The atypical Chinese formulae are all included in 10 separate ones, while in the Japanese list 16 are represented, approaching the 24 found in the Europeans.

From this again comes the conclusion that the Chinese represent a highly specialized race, with an overwhelming preponderance of the two simplest types, and with the remainder limited to a few others (10). The Japanese, although with nearly as large a percentage of the two simplest formulae, yet show a larger variation in the remaining formulae, as well as the presence of several much more primitive ones. Of course this may have no special meaning, but *it is certainly suggestive of an admixture with the Japanese of a more primitive stock*, and that thus they have not succeeded in effacing the final traces of the animal as have the Chinese.

#### 2b THE THENAR REGION OF THE FOOT

The region of the hollow of the foot, along the inner margin from ball to heel, the one which has been tentatively identified with the *Thenar Region* of the hand, indicates again, as does the region of the ball, an extreme degree of effacement of ancestral markings in the prints of the Chinese and Japanese, in contrast to the same region in Europeans.

In a former paper (*Palm and Sole Studies*, *Biol. Bull.* Feb.-Mar., 1916, pp. 157-171) this region received a preliminary treatment in the European foot, and the following points were made:

1. That this region lies quite beyond the limits of the ordinary "tread-area" print, and needs therefore to receive a special treatment by means of an extra patch applied to the inked foot in this region.

2. That a special study of this region reveals a series of loops, distinct area, and triradii, which occasionally occur, and, when not actually present, are indicated by disturbances, such as seams, convergences, or other vestiges, indicative of an original Thenar pattern.

3. That the cause of the loss or reduction of this Thenar pattern has been the result of the emancipation of this area from the ground during walking.

Although, as stated under (1), an ordinary print does not give any account of this region, and consequently most collections of sole prints

furnish nothing upon which to base conclusions, especial pains were taken, in all the prints of Chinese and Japanese, to include with the usual tread-area prints, special records of this region, and it can now be stated definitely that in these people the Thenar region is covered by parallel ridges, with rarely a trace of a pattern, and that here, as in the ball, a complete degeneration of early conditions is shown to a remarkable extent.

Thus in the Japanese females, which were accompanied by exceptionally complete records of the thenar region, we present here the condition in the first fifty individuals on the list (100 soles). The designation (..) means the entire absence of any character other than simple parallel ridges across the foot. An (r) signifies a rudiment, more correctly a vestige, and was given whenever there was the slightest indication of any disturbance, such as a local divergence of a few ridges. A (T) indicates a triradius:

TABLE XXXIX

Occurrence of a Thenar Pattern in Japanese Females

..	..	..	..	..	..	..	..
..	..	..	..	r	..	r	r
..	..	r	..	..	..	..	r
r	..	..	..	r	r	..	..
..	..	..	..	r	r	..	r
r	..	..	..	..	..	r	r
..	..	..	..	..	..	..	..
r	..	r	..	..	..	..	..
..	..	..	..	T	T	..	..
r	..	..	..	..	..	..	..
..	r	r	..	..	..	..	..
..	..	..	..	..	..	r	r
r	..	..	..				

In the whole hundred separate sole records, only 24 have even a trace of anything but monotonous parallel lines, not quite a quarter, and when the (r) represents usually nothing that can be designated as more than a slight divergence or something equally unimportant, this will be considered as almost no indication at all. The two actual triradii (T) occur in the same individual, and are the sole instances of such a pattern. This being so, the individual must be considered an unusual exception, possibly with an admixture of foreign blood. In inspecting the whole collection, and finding so little, one can hardly refrain from regretting that so much pains was taken, and so many separate patches were made,

with so little result. Here, however, as often elsewhere, a negative result is as important as a positive one, and from the perfect printing of the whole series the negative character of the Japanese thenar region can be definitely asserted.

Compare with these a like number from the second series of Smith College students:

TABLE XL  
Occurrence of a Thenar pattern in European-American Females

r	r	..	Tl	l	R	T	T
..	..	R	R	..	r	..	..
Tl	Tl	..	..	..	..	..	r
r	r	r	r	R	R	..	r
r	r	..	T	Tl	Tl	..	r
l	l	r	r	Tl	T	..	r
r	r	r	..	r	r	r	r
..	r	r	R	Tl	Tl	r	r
l	l	r	r	T	T	..	..
..	..	R	R	..	..	..	..
R	R	r	r	..	..	..	..
..	..	..	..	..	r	r	..
r	r	r	r				

In this a distinction is made (r and R) between the merest rudiment and a considerable disturbance; also a further character, the loop (l) is often present. The T, and especially the Tl, is a much more marked feature than is the single T, on the two feet of one Japanese. Further comment is unnecessary.

The Chinese feet are as featureless in this region as are the Japanese. This constitutes a striking difference between the two races here compared.

#### 2c THE HYPOTHENAR REGION OF THE FOOT

As I have already had occasion to bring out,<sup>4</sup> the estimate concerning the occurrence of a hypothenar pattern on the sole depends largely on the amount of outward rolling of the individual prints, for the core of the pattern seldom lies within the area of the tread contact, and in a print that shows simply this tread-area, the hypothenar pattern, although it may be actually present on the foot, seldom shows.

<sup>4</sup> In *Palm and Sole Studies*; *Biol. Bull.* Feb.-Mar. 1916, pp. 157-165.



Thus, in the set of Japanese males, where I had the direct control of the printing, and saw that the prints were well rolled, I got the impression that a hypothenar loop, at least a rudiment, consisting of a convergence of the lines towards a point in one place, was all but universal, while in the Japanese females, where the prints were for the most part taken after my departure, and where I could exercise no such control, this pattern was very rare, and evidently was shown only in those cases where it had been located rather far inwards, and happened to be within the contact surface of a tread-area. In the Chinese it was the same way, except that here it was the Chinese women who were careful to give rolled prints.

On the whole, in both these races, as was previously found among the European-Americans, a hypothenar loop is of common occurrence, although not universal. In several cases a very broad loop was met with, often with the core placed farther back than usual, towards the heel. In general the material was found to be quite insufficient for obtaining anything like definite data concerning this interesting pattern.

#### 2d THE CALCAR REGION

A pattern on the heel is always a great rarity, yet occurs in the European-American race about once in a hundred individuals. The number of Chinese and Japanese individuals is therefore insufficient to expect calcar patterns on the assumption that they are about as rare in Orientals, and the results bear out this assumption. Not a trace of a calcar pattern, or even a disturbance sufficient to be considered a vestige, was found among the Chinese prints (50 males and 50 females), but among the Japanese one pattern was found, No. 1607 of the female set. Here it is seen on the right foot only, and is in the form of a typical loop, opening inwards and forwards, and provided with a triradius, just beyond the curve of the loop, quite as in the typical European-Americans. On the left heel of the same individual the lines converge noticeably, but hardly enough to be considered even the vestige of a pattern.

This exact type of Calcar pattern Hasebe has found in three cases out of 322 separate soles (apparently 161 individuals); and speaks of two instances of loops opening towards the fibular side. This latter he thinks is new, "beschrieben . . . soweit mein Wissen reicht, noch niemals." He figures one case of each type, but the figure of his fibular type, by mistake given a wrong designation (as Fig. 14, instead of 13) and reversed is hard to understand. He is very likely correct, as I have

in my collection of European-Americans, a complete whorl, with two triradii. This extreme rarity occurs in a distinguished zoologist, and forms a recondite mark of distinction, other than his well-known writings. Such a figure, with a failure of the tibial, rather than the fibular, triradius, might easily be conceived as producing Hasebe's fibular loop.

## LITERATURE

### VARIAION—THE TEETH

ODONTOLOGICAL ESSAYS. By Bolk (L.)—*J. Anat.*, 1921, LV, 138-186, 219-234; 1922, LVI, 107-136.

The study is essentially one of histological nature, and is divided into three parts dealing respectively with (1) The Development of the Human Palate and Alveolar Ridge; (2) The Development of the Enamel Germ; and (3) The Tooth-glands in Reptiles and Their Rudiments in Mammals.

Regrettably these detailed and involved papers lack résumés. As to the palate and alveolar ridge, the reader must be referred to the original. Concerning the enamel sack or organ and the tooth germ, the author believes these to be not single, but twin, a buccal and a lingual one, which is true of both the enamel organ and the papilla, and upon this he bases his so-called "dimer" theory. "If in reality, the mammalian enamel-organ be a compound one, the tooth itself also must be of the same nature, built up by two elements each homologous with a reptilian tooth. The buccal cusps of the mammalian tooth should represent then the one, and the lingual cusps the other reptilian tooth. The mammalian tooth should be then, what I will call a 'dimer' tooth."

In the publication of the third part of his paper the author has "aimed at a double purpose. Firstly to make known new facts concerning the development of the dentition in mammals and reptiles, and secondly to enable odontologists to obtain a more exact knowledge of the so-called vestigial premilk-teeth." He is "convinced that many epithelial formations in a mammalian embryo described in literature as vestigial premilk-tooth, are in reality rudiments of the reptilian glandular band."

A fourth part, just published, deals with "The Relation between Reptilian and Mammalian Teeth." The author shows the defects of pre-existing views and endeavors to substantiate the "dimer" theory of his own. The principal points of this theory may be thus summarized:

"The reptilian tooth from which that of the mammals evolved was not of a simple conical or styloid form, as is the current opinion, but possessed a crown with three cusps; a main cone, with anterior and posterior accessory cusps upon its slopes. The three cusps are placed in an antero-posterior linear series.

"Every mammalian tooth with certain exceptions presently to be mentioned, is homologous with two reptilian teeth. The outer half of the mammalian tooth with the series of buccal cusps represents one of these teeth, the inner half with the series of lingual cusps represents the



other. These two parts of the mammalian tooth may be distinguished as: the *protomere* (buccal part) and the *deuteromere* (lingual part).

"The mammalian tooth was not evolved from two reptilian teeth by means of a real coalescence of two separate and independent elements, but in consequence of a concentration of the anlage of two reptilian teeth.

"The elements of a mammalian set of teeth are all morphologically and genetically equivalent. The terms monocuspidate and multicuspidate possess only a descriptive-anatomical value and do not indicate morphogenetic differences. The differences in shape exhibited by the teeth are solely of a quantitative nature. The anlage of every tooth possesses the potentiality of developing all the cusps found in the most complicated tooth of the set. Complication is to be regarded as completeness. Simplicity of a tooth is explained by the fact that the anlage of a tooth develops its potentialities in a more or less incomplete manner.

"These theses form the basis of (the author's) theory regarding the relationship between reptilian and mammalian teeth. The theory may be termed the 'Dimer theory.'"

To which the author adds: "My conceptions run counter to current opinion and will, doubtlessly, be subject to criticism. I would plead however that considered judgment be suspended until the appearance of my fifth essay, in which the second great odontological problem, viz. the relationship between the diphyodonty of mammals and the polyphyodonty of reptiles will be discussed. I hope to prove that the processes of tooth-change in reptiles and mammals are two entirely different phenomena and that the reason for the appearance of the dimerous tooth in the mammal is to be sought for in the profound change which has affected the primitive features of tooth replacement.

"As the two fundamental odontological problems are closely inter-related and both come within the compass of my general conceptions, the complete evidence upon which my theory stands or falls has yet to be unfolded."

A good deal remains to be explained and the fifth installment of these elaborate essays will be awaited with no little interest.

TEETH IN CZECHOSLOVAKIA. The "*Zubní Lékařství*" of Prague (1921, XXI, No. 11), brings the following results of a special examination of the teeth of soldiers in the ČCS. army in the beginning of 1921:

Recruits entering the army showed on the average 20 per cent of teeth lost or with caries. An entirely healthy denture was found in but 5.36 per cent of 11,805 soldiers. A larger series of 40,878 soldiers showed of healthy teeth 78.5, of carious or lost through caries 21.5 per cent. Slovak soldiers, who on the whole proceed from the least cultured districts (results of former Magyar oppression) showed in general a much better condition of teeth than the Czechs and Moravians.

A reference to dental examination of school children in Germany, in 1920, states that the results showed an improvement on conditions existing before the war, as a result apparently of "war" food.

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## ANTHROPOLOGY OF THE OLD AMERICANS

### II. STATURE

ALEŠ HRDLIČKA

The subject of stature in the United States has received considerable attention in the past, through several channels. The three main agencies in this respect were, first, the army and navy, then the colleges and gymnasia, and finally the insurance companies. The object in all these cases was utilitarian. Scientific work proper, so far as American adults are concerned, is as yet practically non-existent.

The mass of data on stature (and weight) accumulated through the above sources is very great, but its value is more or less limited. As a rule the records make no anthropological distinction outside of the nativity of the persons examined, and some of the most extensive data, such as those of the "Medico-Actuarial Mortality Investigations," fail even in this respect. Generally also the series, particularly those of the colleges and the army and navy, include subadults; and the methods of taking the measurement in some of the cases, such as in recruiting in large numbers, as during the Civil and the late war, but also in the insurance examinations, leave much to be desired.

Notwithstanding these defects the accumulated measurements are useful in more than one direction. They give approximate means for the American people at large, and separately those for several groups of the foreign-born. They give the height and other measurements for the selected class of the college students; and, what is of permanent and decided value, they give for both sexes and—if we include the numerous studies on children—for all ages, the correlation of weight with stature.

The data at our disposal from the above sources, on adults and near adults, may briefly and conveniently be shown as follows:

AMER JOUR. PHYS. ANTHROP., Vol. V, No. 3.

## U. S. ARMY AND NAVY

	Years	Nature of Subjects	Reported by	Ages	No. OF SUBJECT (Male)	AVERAGE in.	STATURE cm.
	1840- 56	Native-born Soldiers	Coolidge <sup>1</sup>	"Full <sup>2</sup> stature"	1800	68.8	174.8
	1861- 63	Native-born recruits, U. S. Army	Elliott <sup>3</sup>		25,878	68.2	173.3
	1861- 65	do.	Gould <sup>4</sup>	"full stature"	160,181	68.5	174.
	1861- 65	Native-born recruits, U. S. Navy	do	"full stature"	21,321	approx. 66.8	approx. 169.7
Na- tive Born	1864- 66	do, U. S. Army (spe- cial measurements for the U. S. Sanitary Commission)	do	"full stature"	15,114	approx. 68.4	approx. 173.9
	1861- 65	Enlisted men, U. S. Army (of the North) Native-born	Baxter <sup>5</sup>	all ages, (average stature)	315,620	67.67	171.9
	1861- 65	Enlisted men, U. S. Army (of the North) Native-born	Baxter <sup>5</sup>	25 to over 40 y.	91,373	68.2	173.3
Na- tive Born and Others	1892	Accepted white re- cruits U. S. Army (no Surgeon- distinction as to na- tivity)—(for 1892)	Gen. U.S.A. <sup>6</sup>	20 to 34 yrs.	7,341	67.45	171.35
	1893	do (for 1893)	do <sub>a</sub>	20-50 y.	7,687	67.45	171.35

1) Coolidge (Richard A.)—Statistical report on the sickness and mortality of the army of the United States (1840-1856); 4to, Wash., 1856.

2) Under "full stature" Gould understands the highest attained stature of a person. The age at which this is reached differs in different groups. In the native-born whites of the U. S. full stature appears not to be attained generally until well after the 25th year; though this does not seem to be borne out by newer records (see Fisher, in Hoffman,<sup>6</sup> p. 38).

3) Elliot (E. B.)—On the military statistics of the United States of America. 4to, Berlin, 1863.

4) Gould (B. A.)—Investigations in the military and anthropological statistics of American soldiers. *Mem. U. S. Sanitary Commission*, 8°, N. Y. 1869.

5) Baxter (A. H.)—Statistics, medical and anthropological, of the Provost-Marshall-General's Bureau. 2 vols., 4to, Wash., 1875, 1, 19, 21, 24, 25, 29.

6) Report, Surg.-General, U. S. A. for 1892.

6a) Report, Surg.-Gen. U. S. A., 8°, Wash., 1893, 226-'7. The total number of recruits accepted was 8,555 between the ages of 16 and over 50, and the average stature of the whole number was 67.42 in. or 171.25 cm.



	Years	Nature of Subjects	Reported by	Ages	No. OF SUBJECT (Male)	AVERAGE tn.	STATURE cm.
Na- tive Born	1894	do for 1894 Native-born	do <sub>b</sub>	20-49 y.	4,246	67.52	171.5
	1895	do for 1895 Native-born	do <sub>c</sub>	20-49 y.	5,605	67.68	171.9
	1896	do for 1896 Native-born	do <sub>d</sub>	20-39 y.	5,479	67.75	172.1
Na- tive Born and Others	1906-	Accepted recruits					
	15	U. S. A. (without dis- tinction as to nativity)	Hoffman <sup>7</sup>	21-25 y. & over <sup>8</sup> )	260,060	67.33	171.
	1918	Soldiers, U. S. A. (without distinction as to nativity)	U.S.A. <sup>9</sup> Medical Museum	"Average age 30.9 y."		67.4	171.2
	1917- 18	Recruits at mobiliz <sup>n</sup> U.S.A. (without dis- tinction as to na- tivity or color).	Love <sup>10</sup> & Davenport	21-30 y.	868,445	67.49	171.4
	1919	Soldiers U.S.A. (dur- demobiliz <sup>n</sup> , without distinction as to na- tivity)	Davenport & Love <sup>11</sup>	all ages (prob. 19 to over 30 yrs.)	96,596	67.71	172.

6b) Do, for 1894, 160-1.

6c) Do, for 1895, 180-1.

6d) Do, for 1896, 234-5.

7) Hoffman (Frederick L.)—Army anthropometry and medical rejection statistics. 8°, Newark, N. J., 1918, 31 *et seq.*

8) The averages were: for 21 years—67.3; 22 years—67.3; 23 years—67.3; 24 years—67.4; 25 years and over—67.3 in.

9) Chart in the U. S. A. Medical Museum, based doubtless on the records of the War Department.

10) Love (Albert G.) & Chas. B. Davenport—Physical examination of the first million draft recruits. 8°, Wash., 1919.

11) Davenport (Chas B.) & Albert G. Love—Army Anthropology. *Statistics Med. Dept. U. S. Army in the World War*. 8°, Wash., 1921, 34, 117 *et al.*

This series must be regarded as somewhat selected and also affected by their training and service.

The American soldier, it may be seen from the above records, averages in general, all nativities mixed, between 171 and 172 cm., or roughly between 5 ft. 7½ and 5 feet 7⅔ inches; while the native-born (leaving out the navy and the "full statures") range in their averages, according in the main to locality, between 171.35 and about 173.5 cm., or between 5 feet 7½ and 5 feet 8½ inches.

## U. S. COLLEGE STUDENTS

## MALES

Year	Nativity	College	Reported by	AGES (mean or ex- tremes)	Number of Subjects	AVERAGE in.	Stature cm.
1857-8	U. S. (with few exceptions)	3 Southern Medical (S. C., Tenn., La.)	Dickson <sup>1</sup>	21.5-24.5 yrs.	386	(695) 68.5 <sup>1a</sup>	(176.5) 174. <sup>1a</sup>
1858	No distinction (mainly doubtless U. S.) do	Jefferson Medical Coll. Phila. Ann Arbor Med. Coll.	do do	22 y. 24.5 y.	75 53	(69) 68.— (68.8) 67.8	(175.3) 172.8 (174.75) 172.25
	Native-born	Milit. Acad. West Point	do	20.1 y.	211	(69.—) 68.—	(175.3) 172.8
1865	No distinction (mainly U. S.) Native	Jefferson Med. Coll. Phila. Ky. Med. Coll.	do do	24.5 y. 25 y.	133 34	(68.25) 67.25 (71.—) 71.—	(173.35) 170.85 (180.3) 177.8
1865 (or a little later)	No distinction (but mostly native)	Harvard & Yale	Gould <sup>2</sup>	24-27 y. and over	42	(68.7) 67.7	(174.5) 172.—
1861-9	do	Amherst	Allen <sup>3</sup>	20.3 to slightly over 23 y.	"8 years"	67.8	172.2
1861-88	do	do	Hitchcock & Seelye	16-26	670	67.9	172.5
1860-90	do	do	"	18-25 <sup>6</sup>	1280	68.2	173.2
1884-89	do	do	Hitchcock <sup>7</sup>	21 y. 1 mo.	2000	67.99	172.7

1) Dickson (S. Henry)—Statistics of height and weight. *Am. J. Med. Sc's.*, Phila., 1866, LII, 373-380. (Earlier data by same A. in *Charleston Med. J & Rev.*, 1857, 1858. All given in the latest article). Statures have evidently been taken with shoes and clothes on (See *Charl. Med. J.*, 1858, 504).

1a) After allowance of 1 in. or 2.5 cm. for heel.

2) Gould (B. A.)—Investigations etc., 1869, 130-1 (Stat. with shoes on?)

3) Allen (Nathan)—Physical culture in Amherst College. 8°, Lowell, Mass., 1869, Append., 41.

4) Hitchcock (E.)—& H. H. Seelye—Statistics bearing upon the average and typical student in Amherst College. *J. Anthropol. Inst.*, 1888, XVII, 357-8; also 1889, XVIII, 192-199.

5) The anthropometric tables of Amherst College. 8°, 1892, 7pp, 3 charts (no auth.)

6) Mean stature remained unchanged from the 18-year group.

7) Hitchcock (E.)—A comparative study of average measurements. *Proc. Am. Ass. Adv. Phys. Educ.*, 1891, 37-42. (Embraces Amherst data published before.)

Year	Nativity	College	Reported by	AGES (means or ex- tremes)	Number of Subjects	AVERAGE in.	Stature cm.
Up to 1893	do	Harvard	Sargent <sup>8</sup>	22-26 y.		mean 68.3	mean 173.5
1894-6	do	Columbia	Cattell & Farrand <sup>9</sup>	abt. 17-24 y.	100	abt. 68.1	abt. 173.1
Up to 1902	do	Y.M.C.A. Colleges, etc., Neb., Mass., Conn.	Hastings <sup>10</sup>	20 y. (each)	736	67.8	172.2
n.d.	do	Univ. of Penna.	<sup>11)</sup>	19.6 y. (16.5- 25.7)	2000	mean 67.4	mean 171.2
before 1909	do	Yale	Seaver <sup>12</sup>	20	2700	68.1	173.—
up to 1909	do	U. of Wis.	Elsom <sup>13</sup>	no det.	8000	67.9	172.5
1909-10	do	do. "short course"	do	21.7 y.	150	67.7	172.—
do	do	do (Freshmen)	do	19.7 y.		67.8	172.2
Classes 1910-11	abt. 50% na- tive born	Columbia	Meylan <sup>14</sup>	17-19 y.	790	67.45	171.3
1911-13	Mostly native born	Princeton	Ray- croft <sup>15</sup>	18 y. 9 mo.	1243	68.98	175.2
1915	Mostly native born	U. of Wis.	Elsom <sup>16</sup>	19 y. 8 mo.	1000	68.1	173.—
do	do	Yale	do	20th y.	1000	68.8	174.75

8) Sargent (D. A.)—Anthropometric charts; etc. Fol., Cambridge, 1893 (no text).

9) Cattell (J. McK.) & Livingston Farrand—Physical and mental measurements of the students of Columbia University. *Psychol. Rev.*, 1896, III, 618-648. (Reported as 175.1; but as measurements were taken with shoes on, only 1.4 cm. subtracted for the heel, and in some cases no subtraction was made, it is necessary to make further reduction, which in all probability cannot be substantially less than 2 cm.)

10) Hastings (Wm. H.)—A manual for physical measurements. 4to, Springfield, Mass. 1902, 95.

11) A chart, n. d. (no auth.).

12) Seaver (J. W.)—Anthropometry. 8°, 1909, 95.

13) Elsom (J. C.)—Statistics regarding short course students. Univ. of Wisconsin, 1909-10. *Am. Phys. Educ. Rev.*, 1910, XV, 348-9. (Gives also data on 8,000 students, but no details.)

14) Meylan (G. L.)—Some physical characteristics of college students. *Science*, May 1, 1908, 711-13.

15) Personal communication to the author by Dr. Joseph E. Raycroft, Director of the Dept. of Hygiene and Physical Education, Princeton University. The statures were taken with the students stripped, and apply to the freshmen entering the College. No explanation of the high average (which held for every one of the three years) was suggested.

16) Elsom (J. C.)—Communication to the writer, May 22, 1922.



The male college students, though of a lower mean age, are seen to average (leaving out the old records) between 171.2 and 175.2 cm., or from 5 feet 7 $\frac{3}{5}$  to 5 feet 9 inches. They are of a superior stature to the native soldiers, due doubtless on the average to their better environmental conditions.

## U. S. WOMEN

Year	Nativity	Location	Reported by	MEAN AGE (or limits)	Number of Subjects	AVERAGE Inches	STATURE Centimeters
(1858)	(Mainly born in U. S.)	(Southern States)	Dickson <sup>1</sup>	children to adolescents			
1875	Native-born	Boston & vicinity	Bowditch <sup>2</sup>	18-19 yrs.	118	62.1	157.7
1881	Native-born: parents native-born	Milwaukee	Peckham <sup>3</sup>	17.5-19.5 y.	57	62.9	159.8
1890	Mainly native born	Worcester	Boas & Wissler <sup>4</sup>	21-37 y.	49	62.8	159.6
To 1890	Mainly native born	Schools & Colleges Mass.	Bowditch <sup>5</sup>	17 y. upward	1,107	62.5	158.8
1892	Mainly native born	High Schools St. Louis	Porter <sup>6</sup>	20-21 y.	122	62.8	159.6
To 1893	Mainly native born	Harvard	Sargent <sup>7</sup>	18-26 y.		63.3	160.8
Abt. 1895	Mainly native born	High Schools Oakland, Cal.	Boas <sup>8</sup>	18 y. & older	82	63.1	160.2

1) Dickson (S. Henry)—(Earliest data on American girls). *Charleston Med. J. & Rev.*, 1857, 1858; *Am. J. Med. Sci.* 1866.

2) Bowditch (H. P.)—The Growth of Children. 8th *Ann. Rep. St. Bd. Health*, Mass., 8°, Bost., 1877, pt. II; s. a. Supplem. Investig., Bost., 1879; and XX *Ann. Rep. St. Bd. Health*, Mass. (also in Roberts' *Anthropometry*, 1878, 88-9).

3) Peckham (Geo. W.)—The Growth of Children. 6th & 7th *Ann. Rep. Bd. Health*, Wis., Madison, 1882, 1883.

4) Boas (F.) & Clark, Wissler—Statistics of Growth. *Rep. Commissioner of Educ.* for 1904, Wash., 1905, 118 *et seq.*

5) Bowditch (H. P.)—The Physique of Women in Massachusetts. 21st *Ann. Rep. St. Bd. Health*, Mass., Bost., 1890, 287-304.

6) Porter (Townsend)—The Relation between the Growth of Children and their Deviation from the Physical Type of their Sex and Age. *Trans. Ac. Sc.*, St. Louis, 1893, VI, No. 10, 248-9.

7) Sargent (D. A.)—Anthropometric Charts. Fol., Cambridge, 1893 (no text); also "The United States of America," 1894, II, 452-475.

8) Boas (F.)—The Growth of Toronto Children. *Rep. Commissioner Educ.* for 1897, Wash., 1898, p. 1570.

Year	Nativity	Location	Reported by	MEAN AGE (or limits)	Number of Subjects	AVERAGE STATURE Inches Centimeters	
1897	"White girls of American parentage"	High Schools Washington, D. C.	McDonald <sup>9</sup>	17.7-20.8	194	63.02	160.1
Up to 1899	Mainly native born	Univ. of Nebraska	Clapp <sup>10</sup>	16-25 y.	1500	63.-	160.-
1881-1915	Mainly native born	Wellesley College:					
1881-4		do.	Data communicated to author	19 y.	200	62.8	159.6
1884-9		Holyoke & Wellesley	Hitchcock <sup>11</sup>	nr. 19 y.	"5 Freshman yrs. in each college	62.64	159.1
Up to 1893		Wellesley	Wood <sup>12</sup>	20.1 y.	1600	mean 63.2	mean 160.5
1915		Wellesley	Data communicated to author		200	63.43	161.1
1886-1915	Mainly native born	Oberlin College	Communicated to author <sup>13</sup>	19.25 y.	3200	62.45	159.9
1884-1920	do	Vassar Coll.	Newcomer <sup>14</sup>	18.6	7064	63.94	162.4
1891-1921	Mainly native born	Stanford University	Mosher <sup>15</sup>	"Freshmen"	"20 classes"	63.5	161.3

9) McDonald (A.)—Experimental Study of Children. *Rep. Commissioner Educ.*, 1898, Wash., 1899, 1069.

10) Clapp (Anne L. Barr)—Anthropometric table of Measurements of 1500 College Girls at the University of Nebraska. 1899, 1902. (Also in Siever's "Anthropometry," 1909, 99.)

11) Hitchcock (E.)—A Comparative Study of Average Measurements. *Proc. Am. Ass. Adv. Phys. Educ.*, 1891, 37-42.

12) Wood (M. Anna)—Anthropometric Table Compiled in Percentile Form from the Measurements of 1600 Wellesley Students. 1893. (Also in Siever's "Anthropometry," 1909, 98.)

13) Hanna (Delphine)—Anthropometric Table in Percentile Form from the Measurements of 1500 Women of Oberlin College. 1894. (Also in Siever's "Anthropometry," 1909, 97.)

14) Newcomer (Mabel)—Physical Development of Vassar College Students, 1884-1920. *Quart. Publ. Am. Stat. Ass.*, Dec. 1921, 976-982.

15) Mosher (Clelia D.)—Concerning the Size of Women. *Calif. St. J. Med.*, Feb. 1921.

Year	Nativity	Location	Reported by	MEAN AGE (or limits)	Number of Subjects	AVERAGE STATURE	
						Inches	Centimeters
1901- 1921	do	Smith College	Richards <sup>16</sup>		9655	63.62	161.6
1921-2	Native-born	Berea Coll.	Hutch- ins <sup>17</sup>	19.3 y.	176	63.24	160.6

16) Richards (Elizabeth)—N. Y. Herald, May 8, 1921, Sec. VII, p. 4.

17) Hutchins (Wm. J.)—Transmitted to the author by Professor Hutchins, President of the Berea College. Measurements of the 1921-2 entrance examinations, made by Helen C. Paulison, Director of the Physical Education of Women, Berea Coll., Ky.

The full-grown or nearly full-grown young women of the United States higher schools and colleges, average in stature from approximately 159 cm. or 5 feet 2½ inches to 162.4 cm. or 5 feet 4 inches, without much distinction as to location.

## INSURANCE COMPANIES

Year	Location	Reported by	Number of Subjects	AVERAGE STATURE			
				Men		Women	
				in.	cm.	in.	cm.
1882	Mainly New England	Foster <sup>1</sup>	1,121	68.	172.7		
1897	United States & Canada	Shepherd <sup>2</sup>	74,162				
1900	do	Nat. Frat. Cong. <sup>3</sup>	133,940	nr. 68.	nr. 172.7		
1912		Med.-Act's <sup>4</sup>	Men: 215,183 Women: 120,716	67.75	172.1	63.50	161.3

1) *J. Inst. Actuaries.*, 1885, XXV, 253.

2) *Proc. Assoc. Life Ins. Med. Directors*, 1897.

3) *Proc. XIV Sess. Nat. Frat. Congr.*, Buffalo, 1900, 140.

4) *Medico-Actuarial Mortality Investigation*. 3 vols. 4°, N. Y., 1912, I, 21 *et seq.* The whole male series of 221,819 includes 5227 subjects below 20 and 1409 above 59; the female series of 126,000 including 4596 below 20 and 688 above 59 years of age. The subjects were all measured *in their shoes*. The general averages obtained for stature were 5' 8½" for the men and 5' 4¼" for the women. Discounting the effects of the inclusion of immature and old subjects on one hand and the measuring with shoes on in the other, (with allowance of 1 inch for shoes in males and 1¼ inch in females) the approximate above figures are obtained.

The men and women in the United States at large, or those classes—doubtless the mostly native and better-to-do classes—that apply for insurance, show a mean stature in both sexes that represents about the mean found in higher schools and colleges of the country, though of course the college population is the younger and will finish taller when its "full stature" is completed.



Further comment on the preceding data must of necessity be limited. The records are neither uniform nor highly satisfactory as to nativity, ages or classes of the subjects. They all show plainly however, that the American people are of tall stature; that this condition has in a large measure become generalized; that it dates from a time before the Civil War, probably long before it; and that the stature does not tend to decrease with time, notwithstanding the influx of shorter Europeans, but rather the reverse.

It is a highly interesting and good record, and one that makes doubly desirable the data on the oldest contingents of the American population.

#### OLD AMERICANS

The measurement of stature among the Old Americans extends to 727 men and 212 women in good physical condition.<sup>1</sup> These numbers are not large, but a test of the series by groups of 100 indicates that for the group as a whole they are fairly sufficient. They even permit some geographic comparisons; but details as to special States or regions must be left for future determination.

The main results of this as well as other measurements will be reported throughout in the form of averages, which after all are the simplest and most generally useful expressions of conditions. The composition of the series will be seen in the seriation charts and tables.

#### STATURE IN THE GROUP AS A WHOLE

The average stature of the Old Americans is 174.32 cm. (68.63 in.) in the males and 161.83 cm. (63.71 in.) in the females. The sex difference, 12.49 cm. (M : F : 100 : 92.9), is quite normal and near the general average in white people.

The range between the observed minimum and maximum for the males is approximately 39, for the females 32 cm. or respectively 20.4 and 17.9 percent of the total range which for a series of this size is also quite normal. The standard deviation (m. 5.8. cm. f. 5.39 cm.) and the co-efficient of correlation<sup>2</sup> (m. 3.33%, f. 3.33%), are also normal and rather moderate for white people of mixed parentage.

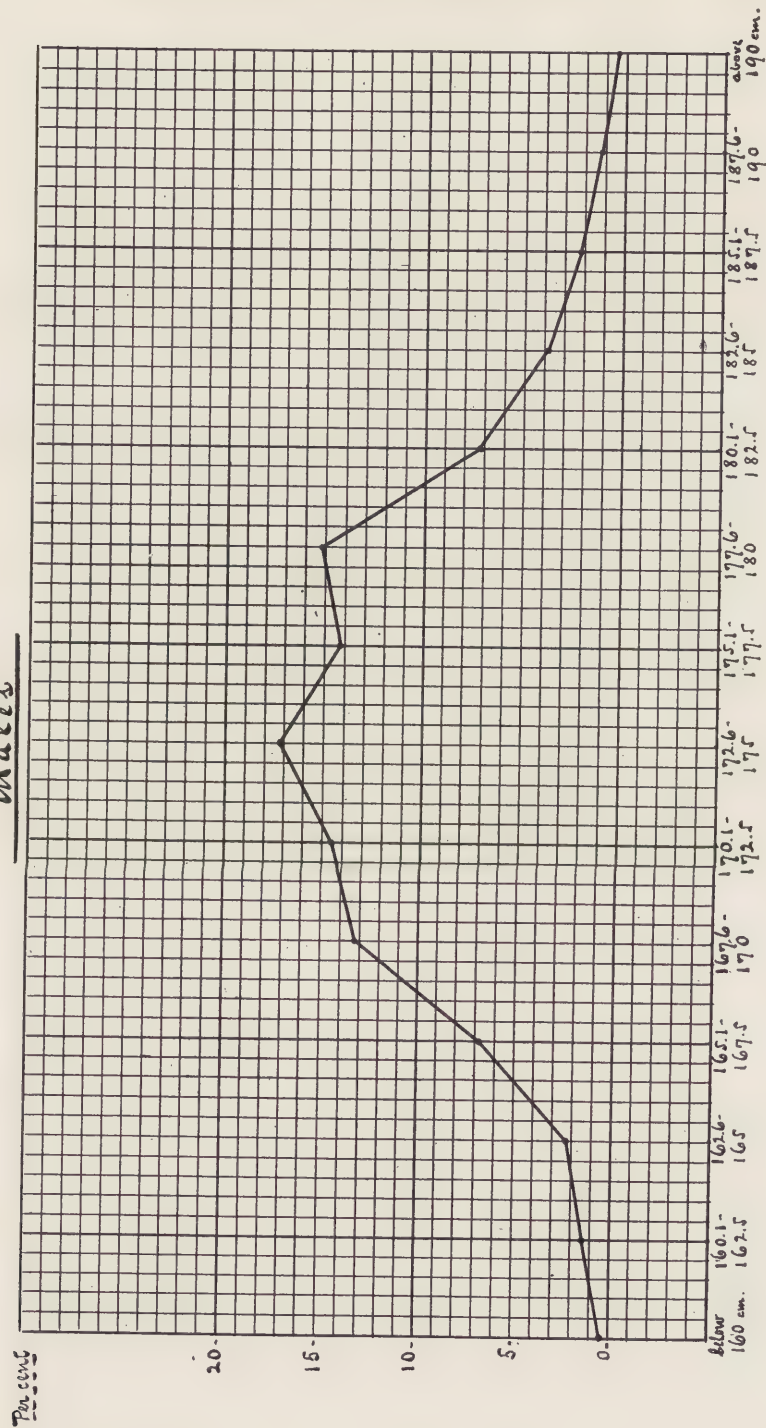
<sup>1</sup> It is barely necessary to state that the measurement here dealt with is the standard anthropometric stature in stocking feet (see author's "Anthropometry," Phila., 1921, Wistar Inst.; also Vol. II of this Journal).

<sup>2</sup> For help with the calculation of which the author is indebted to Dr. C. G. Abbott and Mr. F. E. Fowle of the Anthropological Laboratory, Smithsonian Institution.



# Old Americans: Distribution of Stature

## Males





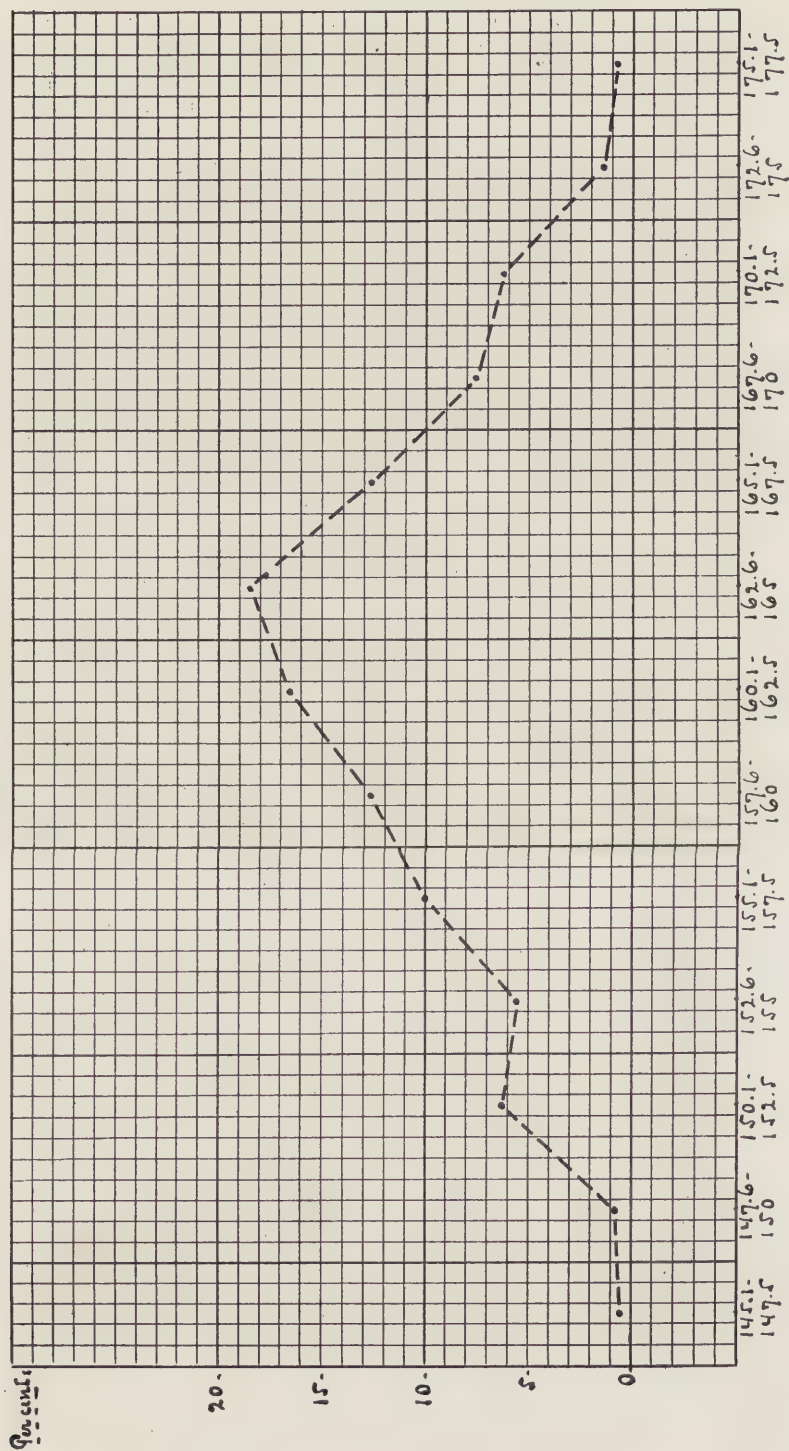
OLD AMERICANS, FEMALES: STATURE  
Number of individuals measured: 211  
Average: 161.85 cm. (63.71 in.). (1st 100: 161.3; 2nd 100 : 162.2)  
Minimum: 145.5 cm. Maximum: 177.3 cm.  
Standard deviation 5.39 cm.; Coefficient of variation 3.33%.

Table of frequencies:

	145.1-147.5 cm.	147.6-150.1 cm.	150.1-152.5 cm.	152.6-155.1 cm.	155.1-157.5 cm.	157.6-160.1 cm.	160.1-162.5 cm.	162.6-165.1 cm.	165.1-167.5 cm.	167.6-170.1 cm.	170.1-172.5 cm.	172.6-175.1 cm.	175.1-177.5 cm.
Number of cases.....	1	2	13	12	21	27	35	39	27	16	13	3	2
Percent.....	0.5	0.9	6.2	5.7	10	12.8	16.6	18.5	12.8	7.6	6.2	1.4	0.9

Difference between Males and Females : 12.49 cm.  
F : M :: 92.9 : 100

# Old Americans: Distribution of Stature Females



The averages for groups of 100, and the distribution of the measurements, are shown in the accompanying tables and charts. The form of these, particularly in the females, is that of a heterogeneous but fairly well mixed population. There is no evidence of any tendency towards a persistence of two or more ancestral types, but rather of one towards a fusion into a single new grouping.

The averages exceed, by approximately two-thirds of an inch (or 2 cm.), those of Americans in general and even those of the native-born (see previous tables) a good proportion of whom are second (or more) generation Americans; and as they hold true for every subdivision of the series, we may regard as established the first fact of importance, which is that in general the Old Americans are the tallest among the American people.

Upon comparison they are also seen to be the tallest, both as to men and women, of all the existing other larger groups of the white race. This will be seen plainly from the following data, which are limited to males, but what is true of males in this respect is true of both sexes.

THE STATURE OF THE OLD AMERICANS CONTRASTED WITH THAT OF OTHER WHITE PEOPLES

Year	No. of Subjects	People	Reported by	Average Stature	Year	No. of Subjects	People	Reported by	Average Stature
1912-1921	727	Old Americans	Present Report	cm. 174.3	1869	2,678	Scotchmen	Beddoe <sup>4</sup>	172.
1861-65	7,313	Scotchmen	Gould <sup>1</sup>	170.8	1883	1,304	"	British <sup>5</sup> Committee	172.97
"	3,478	"	"Full Stat-ure" <sup>1a</sup>	171.65	1919	2,074	"	Davenport & Love <sup>6</sup>	172.5
"	3,476	"	Baxter <sup>2</sup>	170.4					
"	5,731	"	" 3	172.5	1861-65	2,290	Norwegians	Baxter <sup>7</sup>	171.4

1) Gould (B. A.)—Investigations in the military and anthropological statistics of American soldiers. 8°, N. Y., 1869, 105.

1a) Stature of full grown men (during years when no more increase nor any diminution are yet observable).

2) Baxter (J. H.)—Statistics, medical and anthropological of the Civil War. 4to, Wash., 1875, I, 23. Scotch in U. S. Army.

3) "Army Contractor" of the *Edinb. Med. & Surg. J.* (quoted by Baxter, I, LXXI).

4) Beddoe (John)—On the stature & bulk of man in the British Isles. *Mem. Anthropol. Soc.*, Lond., 1869, III, 545; also in sep., 8°, Lond., 1870. Believes (p. 164) the average stature for Scotchmen to be "perhaps as high as 5 ft. 7½ in. (171.4 cm.)."

5) Final report of the Anthropometric Committee. *Rep. B. A. A. S.*, 1883, 256. (Due to an error in computation the report gives the height as 174.6 cm. or 68.71 in. As this figure was out of harmony with any of the other larger records on the Scotch, the writer re-counted the data, and they give the average of 68.1 in. or 172.97 cm. The error here mentioned has been widely copied (see Deniker, Martin etc.).

6) Davenport (Charles B.) & Albert G. Love—Army Anthropology, 8°, Wash., 1921, 113 (Soldiers during demobilization).



Year	No. of Subjects	People	Reported by	Average Stature	Year	No. of Subjects	People	Reported by	Average Stature
1865	3,790	"Scan- dinavi- ans"	Gould <sup>8</sup>	171.35	1861- 65	30,037	English	Gould <sup>23</sup>	170.1
					bef.				
1913	16,532	Norwe- gians	a. Hoffman <sup>9</sup>	171.8	1870	2,068	"	Beddoe <sup>24</sup>	170.15
					1861- 65	8,899	"	Gould <sup>25</sup>	170.16
bef.					1875- 83	6,194	"	A. C. <sup>26</sup>	171.2
1900	106,446	"	a. Deniker <sup>10</sup>	172.	bef.				
1861- 65	1,190	Swedes	Baxter <sup>11</sup>	169.9	1900	3,000	Danes	a. Deni- ker <sup>27</sup>	168.5
bef.					1916	18,727	"	a. Hoff- man <sup>28</sup>	169.
1900	232,367	"	a. Deniker <sup>12</sup>	170.5	bef.	4,964	Schles- wig	a. Deni- ker <sup>29</sup>	169.2
1914	32,322	"	a. Hoffman <sup>13</sup>	171.86	1900				
1861- 65	467	Irish	Gould <sup>14</sup>	169.3	1861- 65	383	Danes	Baxter <sup>30</sup>	169.3
"	50,537	"	Baxter <sup>15</sup>	169.5					
"	88,128	"	Gould <sup>16</sup>	170.	1861- 65	1,104	Welsh	Baxter <sup>31</sup>	168.7
"	24,149	"	Gould <sup>16a</sup>	170.5					
bef.					1875- 83	741	"	A. C. <sup>32</sup>	169.4
1870		"	Beddoe <sup>17</sup>	ap- prox. 169.3	1861- 65	256	Ger- mans	Gould <sup>33</sup>	168.8
"	1,517	"	" <sup>17a</sup>	170.8	"	54,944	"	Baxter <sup>34</sup>	169.
					"	89,021	"	Gould <sup>35</sup>	169.3
1919	6,164	"	Davenport & Love <sup>18</sup>	171.36	"	32,259	"	" <sup>36</sup>	169.5
1861- 65	520	Canad- ians	Gould <sup>19</sup>	169.9	1831- 62		French	Elliott <sup>37</sup>	165.5
"	31,698	"	" <sup>20</sup>	170.7	1861- 65	3,243	"	Baxter <sup>38</sup>	168.3
"	6,667	"	" <sup>20a</sup>	171.6	"	6,809	"	Gould <sup>39</sup>	169.
1860- 65	16,196	English	Baxter <sup>21</sup>	169.1	1919	1,457	"	Daven- port & Love <sup>40</sup>	168.6
bef.				approx.					
1870	1,886	"	Beddoe <sup>22</sup>	169.3					

7) *o. c.* I, 23. Norwegians enlisted in the U. S. Army.8) *o. c.* 125. "Full stature" of Norwegian soldiers, U. S. A.

9) Hoffman (Fred. L.)—Army anthropometry and medical rejection statistics. 8°, Newark, N. J., 1918, 31-2. Conscription in Norway.

- 10) Deniker (J.)—The races of man. 12mo, Lond., 1900. Norway soldiers.
- 11) *o. c.* I, 23. Swedes in U. S. Army.
- 12) The races of man, 1900. Soldiers of Sweden.
- 13) *o. c.* 31-32. Swedish conscripts.
- 14) *o. c.* 284. Soldiers examined for the U. S. Sanitary Commission.
- 15) *o. c.* I, 23. Soldiers in U. S. Army.
- 16) *o. c.* 105. Enlisted men, U. S. Army.
- 16a) *o. c.* 125. "Full stature" soldiers, U. S. Army.
- 17) *o. c.* 164.
- 17a) *o. c.* 145. Recruits, 23 years and upwards.
- 18) *o. c.* 113. Soldiers U. S. Army during demobilization.
- 19) *o. c.* 276. Soldiers U. S. Army measured for U. S. Sanitary Commission.
- 20) *o. c.* 104. Soldiers U. S. Army.
- 20a) *o. c.* 125. do "full stature."
- 21) *o. c.* I, 21, 23. Enlisted men in the U. S. Army.
- 22) *o. c.* 163. Englishmen at large, all England, all classes.
- 23) *o. c.* 105. Soldiers U. S. Army.
- 24) *o. c.* 145. English recruits 23 years and upwards.
- 25) *o. c.* 125. "Full stature" men enlisted in U. S. Army.
- 26) Final Report of the Anthropometric Committee. *Rep. B. A. A. S.* for 1883, (Lond. 1884) 256. Males (at large) 23-50 years of age.
- 27) *o. c.* Soldiers.
- 28) *o. c.* 31-32. Conscripts in Denmark.
- 29) *o. c.* Soldiers.
- 30) *o. c.* I, 23. Enlisted men in U. S. Army. See also Westergaard (H.)—Investigations on the stature of the male population in Denmark. *Med. Danmarks Antrop.*, 1911, I, 351.
- 31) *o. c.* I, 23. Enlisted men U. S. Army.
- 32) *o. c.* (ref. 25), 256.
- 33) *o. c.* 284. U. S. Army; measured for the U. S. Sanitary Commission.
- 34) *o. c.* I, 21, 23. Enlisted in U. S. Army.
- 35) *o. c.* 105.
- 36) *o. c.* 125. "Full stature" enlisted men U. S. Army.
- 37) Elliott (E. B.)—On the military statistics of the United States of America. 4to, Berlin, 1863 16.
- 38) *o. c.* I, 23. Enlisted U. S. Army.
- 39) *o. c.* 105. do. (See also p. 179.)
- 40) *o. c.* 113. do. (Measured at demobilization.)

#### STATURE AND AGE

That age, even after the adult stage of life (full second denture) has been reached, has still an influence upon stature, has long been known and has been discussed by many authors,<sup>3</sup> but the data of various observers and lands show little agreement. What is known in general is that growth in height ceases decidedly sooner in the females than in the males; that in individual males a full stature may be reached even as early as the twentieth year; but that in the majority there is a slight increase even after 24, and that in some men and probably under special circumstances, growth may continue to and rarely even slightly beyond the thirtieth year. It is further known that with the setting in

<sup>3</sup> See especially Topinard (P.)—étude sur la taille. *Rev. d'Anthrop.*, 1876, V, 34 et seq. Also Pagliani (L.)—I fattori della statura umana. Rome, 1877; abstr. in *Bull. Soc. d'Anthrop.* Paris, 1877, 623-32; Martin (R.)—Lehrbuch der Anthropologie, 1914.

of senility, which again differs considerably in different individuals and in the intensity or evenness of its course in the same individual, the stature begins to diminish. There is further a strong probability that there are racial and environmental, as there are class, occupational and still other differences, in these respects, all of which calls for much further investigation.

As to the present series of observations on the Old Americans, we are unable, on account of the relatively small numbers available, to go into any great details, which must be left to special studies. But so far as age is concerned, a few tests show that the general average statures obtained on the whole group are only slightly inferior to the "full statures" in this group. This can best be shown in the following manner:

FULL STATURE IN THE OLD AMERICANS  
(LABORATORY SERIES)

GENERAL AVERAGE		AVERAGE "FULL STATURE" (in those of 30-50 years incl.)		AVERAGE STATURE (in those of 26 years or less)	
Males	Females	Males	Females	Males	Females
(247)	(211)	(114)	(104)	(50)	(46)
174.4	161.83	174.8	162.1	174.03	162.3

#### GEOGRAPHIC DIFFERENCES

Previous data on the native-born and on Americans in general, seem to indicate marked regional differences in stature. There is a great array of records on this point from the Civil and the World War, and these records up to certain points show remarkable agreement. The most copious figures are those of Gould:

STATURE BY STATES AND NATIVITY (Gould)<sup>4</sup>  
I. WHITE SOLDIERS, CIVIL WAR, REGARDLESS OF NATIVITY

	Number of men	AVERAGE STATURE			Number of men	AVERAGE STATURE	
		in.	cm.			in.	cm.
New England	943	67.27	170.9	Western States (east of Miss.)	478	67.73	172.
N. Y., N. J., & Pa.	3,252	67.10	170.4	Slave States	2,024	68.22	173.3

<sup>4</sup> Investigations etc., 125, 251, 284.



## II. WHITE SOLDIERS, CIVIL WAR (GOULD)

REGARDLESS OF NATIONALITY				NATIVE-BORN		
New England	1,211	67.20	170.7	33,783	68.32	173.5
N. Y., N. J., Pa.	3,765	67.14	170.5	61,351	68.11	173.
Ohio & Indiana	1,662	67.74	172.1	34,206	68.97	175.2
Mich., Wis., Ill.	1,016	67.26	170.8	4,570	68.86	174.9
Slave States (except Ky. & Tenn.)	367	67.56	171.6	13,409	68.84	174.86
Kentucky, Tenn.	267	68.53	174.1	12,862	69.30	176.

III. WHITE ENLISTED MEN, CIVIL WAR (BAXTER)<sup>5</sup>

## American-Born

## Average Stature

<i>The Tallest</i>		<i>The Shortest</i>	
Kentucky.....	174.4 cm.	Rhode Island.....	170.9 cm.
Kansas.....	174.1 "	New York.....	170.88 "
Minnesota.....	173.7 "	New Jersey.....	170.2 "
Missouri.....	173.6 "	New Hampshire.....	170. "
California.....	173.5 "	Massachusetts.....	169.9 "
		Connecticut.....	169.1 "

IV. SOLDIERS, WORLD WAR, AT DEMOBILIZATION (DAVENPORT & LOVE)<sup>6</sup>

## Tall to Tallest

## Short to Shortest

State	Number	From Section Characterized by	AVER. STAT. in. cm.	State	Number	From Section Characterized by	AVER. STAT. in. cm.
N. C.	2,738	Sparsely populated mountain- ous area	68.67 174.4	N. Y.	6,544	Urban area	66.95 170.1
Ark.	1,559	Large na- tive white population; hill coun- try	68.64 174.3	Mass.	8,587	Urban area	66.94 170.
Mo.	1,139	Native white, Ozark region	68.63 174.3	N. J.	12,181	Mountain- ous area plus Atlan- tic County; Plains sec- tion, rural	66.83 169.7

<sup>5</sup> Statistics, etc., I, 29.<sup>6</sup> Army Anthropology, etc. 35. 101-3, *et seq.*

State	Number	From Section Characterized by	AVER. STAT in. cm.	State	Number	From Section Characterized by	AVER. STAT in. cm.
Texas	22,372	Sparsely settled, white	68.50 174.	Pa.	14,218	Rural area, native stock	66.73 169.5
Minn.	6,461	Population largely of Scandina- vian deri- vation	68.44 173.8	"	16,085	Urban area	66.62 169.2
Tenn.	5,900	Mountain- ous region	68.43 173.8	N. Y.	46,718	Urban area densely populated	66.46 168.8
Ky.	4,033	Mountain- ous area, native white	68.21 173.3	R. I.	3,928	State undi- vided	66.40 168.7

At the time of the Civil War, the tallest men were those of Kentucky, with Tennessee and the other southern states following; during the World War the palm seems to have passed to certain sections of North Carolina, Arkansas and Missouri. The records in the latter case are somewhat less comprehensive in numbers and more extensive as to geographical distribution, nevertheless the showing of Kentucky calls for explanation which probably will necessitate local studies. The relatively poor showing, both during 1861-5 and in 1919 of most of the New England and Middle Atlantic States, is generally and doubtless justly attributed, in the main, to the large proportion of foreign element in their population.

The records on the Old Americans, as far as they go, show no regional differences of importance as will be seen from the following averages:

STATURE IN OLD AMERICANS, REGIONALLY

*Males*

General Average	Laboratory (all States)	Eastern Tennessee (Mountains & Foothills)	Virginia (& neighboring States)
(727)	(247)	(133)	(347)
174.3	174.4	174.3	174.2

It is strongly probable that if we had comprehensive series of measurements from many regions there would be some variation in the means; but it is plain that the old stock from State to State or region to region

is much more uniform in the average stature than is the general American population. It is apparently not so much the exact locality but what America stands for in general that favorably affects the growth of the body; and the relatively low mean statures for the population at large in the eastern States is evidently wholly due to the presence and admixture with shorter people of more recent American and European parentage.

That the high mean<sup>7</sup> stature of the Old Americans is an American acquisition and not a hereditary condition, is substantiated on the one hand by the fact that no ancestry of such average height is known or indicated by any evidence there is on the subject, and on the other by the change having been actually observed. Thus Gould showed (Investigations etc. 126-7) that natives of New England and New York enlisting in the "west" (west of the Alleghany Mountains) gave in all the stages (at all ages) a higher stature than those enlisting in their native States. This was especially marked for those from New York. The mean excess for New Englanders was near  $\frac{1}{4}$  in., or 0.58 cm.; that for New Yorkers being near  $\frac{1}{2}$  in., or 1.24 cm. In many of the Old American families, moreover, and even in numerous families of a more recent coming, the increase of stature in the younger generation has well been noted by those concerned and their friends.

#### CAUSES

What are the causes of this marked and widespread increase in stature in the United States? They could probably be summed up most simply as *a favorable change of environment*, using the term environment in its broadest sense. It was the stimulation by the American conditions as they have existed in the past and to a material extent still exist, of the mind as well as the body, at the same time furnishing the latter with ample nourishment. It was the pioneer life, it was and is the more wholesome housing, the more largely outdoor life with plentiful food and especially meat, the absence of stunting child labor, the sports of the youth. It was and is probably nothing peculiar chemically or dynamically in the new land, though something of this nature may have helped in some sections.

A highly interesting problem is whether or not this tendency towards greater height of the body is still present in the Old Americans. There are good indications that it is still active in the new comers. There are

<sup>7</sup> The terms 'mean' and 'average' are for convenience used interchangeably and both denote the average, unless it should be otherwise specified.



also data that the average height of the students for same ages has been increasing in many if not all of the colleges, without a marked change in the character of their students as far as age, nativity or class is concerned. But there are also data, particularly those of the Army, which would seem to indicate that the optimum of mean stature may already have been reached and perhaps even passed in many localities. The subject demands a special inquiry with many additional data. The records bearing on the point are as follows:

Dr. Seaver, writing in 1909<sup>8</sup> says, "A percentile study of the records of the Yale students who were in their 20th year of life has been made and the result is shown on the chart on p. 95. A noticeable feature of the results is that this tabulation seems to show a decided tendency to increase in height of students in recent years. This has also been noted in the average tables that have been made at Yale from the records of the freshmen." As may be seen from the table of statures of college students, the average height of Yale students up to 1909 was 173.cm., while in 1915 it is reported to have been 174.75 cm.

At Princeton,<sup>9</sup> the entrance examinations for 1911-'13—the only records of this nature, regrettably, for the present available—showed the following conditions:

STATURE OF PRINCETON MEN

Freshmen entering	Number of individuals	Average Age	Average Height cm.	Average Weight k.
1911	400	18 y. 11 mos.	174.34	63.36
1912	415	16 y. 8 mos.	175.44	63.17
1913	428	18 y. 7 mos.	175.7	63.2

There are especially good data of this nature on the women. Dr. Clelia D. Mosher of the Stanford University, has given us<sup>10</sup> the entrance examination measurements of 4023 young women of that University. They are as follows:

AVERAGE STATURE OF 4,023 WOMEN OF THE STANFORD UNIVERSITY, CALIFORNIA

	Number	in.	cm.
1891-2 — 1900-1 .....	1,116	63.2	160.53
1901-2 — 1910-1 .....	1,200	63.5	161.29
1911-12—1920-21 .....	1,707	63.8	162.05

<sup>8</sup> Seaver (J. W.)—Anthropometry, 8°, New Haven, 1909, 94.

<sup>9</sup> Information in a letter of June 24, 1922, by Dr. Joseph E. Raycroft, Director of the Department of Hygiene and Physical Education, Princeton University.

<sup>10</sup> Concerning the size of women. Calif. St. J. Med., Feb. 1921.

On the basis of these data Dr. Mosher believes that the modern American girl is an inch or an inch and a tenth taller than her sister of thirty years ago, and this "in spite of the fact that the average age of the women entering the University has grown less" (p. 54). And similar data come from the Oberlin, Smith and Vassar Colleges:

WOMEN OF OBERLIN COLLEGE, OHIO<sup>11</sup>

	Number	Mean Age	Mean Stature	
			in.	cm.
1886-1903.....	1,600	19.3 y.	62.6	159.
1909-1915.....	1,600	19.2 y.	63.3	160.8

WOMEN OF SMITH COLLEGE, MASS.<sup>12</sup>

	Number	Average Stature	
		in.	cm.
1903-1909.....	2,322	63.36	160.85
1910-1919 <sup>13</sup> .....	4,332	63.48	161.24
1920-1924.....	3,001	63.98	162.47

## WOMEN OF VASSAR COLLEGE, N. Y.

AGES AND STATURE OF STUDENTS AVERAGED BY FIVE-YEAR GROUPS, 1884-1920<sup>14</sup>

	Number	Means (Years)	Aver. Stature (cm.)
1884-1890.....	307	18.8	160.5
1891-1895.....	621	19.0	160.4
1896-1900.....	992	19.0	161.5
1901-1905.....	1,172	18.9	162.4
1906-1910.....	1,272	18.7	162.6
1911-1915.....	1,482	18.5	163.
1916-1920.....	1,236	18.2	163.7

There are indications that Bryn Mawr, Wellesley, and still other female colleges, show similar conditions.

The evidence, for the women at least, is so general and uniform that it cannot but be accepted as conclusive. But the college student is, on the whole, about the most favored class of the population. The native

<sup>11</sup> Information given to the writer by the Director of Physical Education, Oberlin College, May 14, 1922.

<sup>12</sup> Richards (Elizabeth)—N. Y. Herald, May 8, 1921, Sec. VII, p. 4.

<sup>13</sup> Exc. 1912.

<sup>14</sup> Newcomer (Mabel)—Physical development of Vassar College students. *Quart. Publ. Am. Stat. Assn.*, Dec. 1921, 976-'82; Final report, *Am. J. Phys. Anthropol.*, this issue.

stock workmen class, the native stock farmer class, in general, are probably not increasing in stature any more, or some evidence of such an increase would have become apparent from the measurements of the recruits and the enlisted men during the late war.

As to how long and how far changes of this nature may proceed, we may only surmise. It is noticeable that few of the college groups exceed, and a good many do not yet reach the general averages of the Old Americans. It has also been noted, in the course of the work on the Old Americans, that the oldest of these, the people of five to seven generations American born on each side, were not conspicuous for a higher stature than the rest of the group, though some difference might possibly be found if we could get a good sized unselected series of such individuals. It is not improbable therefore that the present standards of stature in the old United States stock represent, or represent very nearly, the maximum of mean stature attainable by the American people under present conditions. Should these conditions remain about the same, the average stature might then be expected to become fairly stationary; should they grow worse through over-population and untoward changes in habits, the stature would doubtless begin to fall; but should favorable new strong stimuli keep on evolving, the stature could well be expected to keep on responding, until such standards were reached beyond which the increase would begin to prove a disadvantage.

Suffice it to say, that the Old American stock, both men and women, is the tallest of any larger group of white people; that under the influence of favorable stimuli and good nutrition the younger elements of the population at large are advancing in the same direction; and that under the influence of hygiene, of proper physical training, of plentiful highly nourishing food, and of the many outdoor and indoor sports, the advance is particularly noted in the students of our Colleges.

#### INFLUENCE OF TYPE

The influence of type upon the stature in the Old Americans, as in related groups, appears to be quite secondary. The assumed influence of blonds as carriers of a higher stature is not sustained. Imperfect as they are, we have some valuable data on this point from the Civil War:



STATURE IN LIGHT AND DARK COMPLEXIONED MEN<sup>15</sup>

Nativity	Light complexioned	Dark complexioned	Mean height of Lights	Mean height of Darks
<i>United States</i>	126,445	64,176	171.84	172.15
British America	9,506	4,859	170.61	170.37
England	6,804	2,845	169.12	169.22
Ireland	20,378	8,617	169.56	169.56
Germany	20,559	9,041	168.99	168.98

Two consecutive series of "lights" and "darks" among the Old Americans give the following harmonizing results:

STATURE IN "LIGHTS"<sup>16</sup> AND "DARKS"<sup>17</sup> AMONG OLD AMERICANS

MALE					
<i>Lights</i>			<i>Darks</i>		
	Average Stature	Below 170.— Above 175.—		Average Stature	Below 170.— Above 175.—
First series:	25-172.8	8      8		25-173.1	8      10
Second series	25-174.1	8      8		25-174.2	4      10

The results are wholly in accord with the data of the Civil War. The lights (blonds and near) have average stature very near the same as the darks (brunets). If anything there is a slight excess in favor of the darks. In the first series (Laboratory, all States) both these purer strains are below the average height of the intermediates; in the second, (Virginia and neighboring States) they are just about the average (174.2 cm.) of the series.

## INFLUENCE OF CLASS, OCCUPATION, ENVIRONMENT

As to probable class, occupational, and city *vs* country differences, special further studies will be required on much larger numbers. It is known that in general the well-to-do classes, the prosperous farmer and rancher, and the men engaged in healthy outdoor occupations, show a higher stature than the poor, the city workman and those of confining or unhealthy occupations, and it may probably be safely assumed that the same holds true in these respects for the Old Americans.

## STATURE IN TENNESSEE

The stature in Tennessee was obtained in the eastern part of the State on the young men called by the draft in 1917. Part of the men (51) came from the lower lands and foothills about Bristol; part (82) from the

<sup>15</sup> Baxter (J. H.)—Statistics etc., I, 24.

<sup>16</sup> Both hair and eyes light.

<sup>17</sup> Both hair and eyes dark.

rugged mountain country about Mountain City. In both regions the ages of the young men ranged from 21 to 31 years, the mean for the mountaineers being 26.1, that for the men of the lower lands 24.5 years. The average stature of the mountaineers was 173.96 cm., that of the younger lowlanders 174.8 cm. The average stature of the 26 mountaineers from 21 to 24 years of age was 173.9, that of the 28 lowlanders of same ages 175.03 cm. The families of the lower lands, which in general are of the same derivation as those of the mountains, are on the whole better off and there is less alcohol.

#### VIRGINIA AND NEIGHBORING REGION

The measurements secured with Professor Bean's help at the University of Virginia comprised 347 members of a forming regiment of U. S. Engineers. These men ranged from 19 to 37 years of age, the bulk being between 22 and 30. They included essentially various sorts of mechanics. The average stature of the whole group was 174.2 cm., which is practically identical with the general average of 174.32 cm. for all Old Americans. The eighty-six older men of the group, ranging from 27 to 37 years inclusive, gave an average stature of 174. cm., the 261 younger men, 19-26 years old, that of 174.83 cm. The younger generation, as in other subdivisions of our series, appears to be actually or potentially in height slightly above the older men as well as women, which would seem to indicate that a slight increase of stature may still be going on in the Old Americans.

#### KENTUCKY AND OTHER SOUTHERN STATES

The remarkable showing of Kentucky during the Civil War, when it stood at the head of all the States of the Union in the mean stature of its men, and the showing of the State during the World War, when it no longer occupied the first place in this respect, though still among the highest, induced the writer to address the various Colleges in that State for recent data on their students which might possibly throw light on the exact conditions. The appeal came unfortunately too close to the end of the academic year for immediate response, but it was received favorably; and one of the most important schools, the Berea College, through its President, Professor William J. Hutchins, has sent us the height measurements of 176 young women from Kentucky and other southern States, entering the College during the current year. These measurements, made by Miss Helen C. Paulison, the Director of Physical Education of Women at the College, show the following interesting conditions:

## STATURE OF WOMEN IN KENTUCKY AND OTHER SOUTHERN STATES

	Number of Subjects	Average Age	Average Height (in bare feet)	
			in.	cm.
Kentucky.....	123	19 y.	63.16	160.4
Other States (Tenn., Va., W. Va., N. & S. Carolina, Ala., Ga., Fla., Texas).....	53	19.6 y.	63.32	160.8

Having received the individual records, it was possible to reduce these series to women over 20 years of age, in whom the stature is doubtless very near the full stature, with the following results:

## FULL STATURE (OR NEAR) IN WOMEN OF KENTUCKY AND OTHER SOUTHERN STATES

	Number of Subjects	Average Age	Average Height	
			in.	cm.
Kentucky.....	33	near 22 y.	63.75	161.9
Other Southern States.....	26	22 y.	64.68	164.3

A large majority of these women are doubtless of the "Old Americans." The average stature of the women of this group is, as recorded in preceding pages, 63.71 in. or 161.83 cm., or practically identical with that of the above group from Kentucky. The girls from the other southern States (mostly Virginia, West Virginia and Tennessee) are higher. This would seem to agree with the World War data on southern men. But the above groups are too small to be taken as conclusive and we must await further records.

## STATURE OF IMMIGRANTS TO THE UNITED STATES

In connection with preceding data it will be of interest to see about what, in stature, we have been recently receiving from Europe. Before the World War a careful series of anthropometric observations were made by the writer, and under his direction by the Surgeons of the Public Health Service, on healthy, unselected, fully adult and not senile immigrants of twelve nationalities at Ellis Island.<sup>18</sup> The series are not large, yet they give probably a fair indication of conditions,

<sup>18</sup> Credit for this work, the results of which will be published in time are due in the first place to Surgeon-General Rupert Blue, whose sympathetic attitude made it possible, and in the second place to Asst. Surgeon M. K. Gwyn, who after due instruction took the bulk of the measurements.



the data agreeing closely with those from other sources on the same groups. They are (with the exception of the English who gave 170.2, but where the series was too small for anything approaching definite showing) as follows:

AVERAGE STATURE OF ADULT MALE IMMIGRANTS INTO THE UNITED STATES, 1913-1914

50	Croatians.....	171.6	50	Greeks.....	168.3
35	Irish.....	171.6	25	Armenians.....	167.4
50	Poles.....	170.4	50	Magyars.....	166.5
50	Russians (non-Jews).....	169.8	50	Jews (Russian).....	164.6
50	Italians (north).....	169.6	50	Italians (south).....	163.4
50	Roumanians.....	168.7			



## CLIMATE AND RACE AS FACTORS INFLUENCING THE WEIGHT OF THE NEWBORN

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While a number of conditions such as the sex of the child, the age of the mother, and the number of previous pregnancies, are known to affect the weight of the newborn, still other factors are open to question or are little known. Among the latter are the effects of seasonal variations in temperature and differences in race. It is the purpose of this paper to present a study of these two factors based on an examination of the birth records of upwards of 2000 Minneapolis children as given in the obstetrical charts of the Minneapolis General Hospital, the Swedish Hospital, and the University Hospital for the four years from 1915 to 1919. The study was made under the direction of Dr. R. E. Scammon to whom the writer is indebted for advice and supervision.

### I. SEASONAL DIFFERENCES IN BIRTH-WEIGHT

That older infants and children show seasonal variations of growth in weight and height has long been known, the question having been studied in detail by Malling-Hansen,<sup>1</sup> Bleyer,<sup>2</sup> Montessori,<sup>3</sup> Daffner,<sup>4</sup> Camerer,<sup>5</sup> and others. While these observers have recognized various periods of increased or decreased rates of growth in the annual cycle they are in agreement that, in general, growth in both height and weight is more active in the warmer than in the colder months of the year. These conclusions have led to the examination by various workers of the weight and length of the newborn in order to determine whether similar seasonal variations occur at birth.

The first study of this kind was made by Adersen<sup>6</sup> in 1899. He examined the records of the birth weights and birth lengths of 2960 children born in Stockholm. He found that newborn children are larger in the first (colder) part of the year than those of the succeeding months. In 1913 Hansen,<sup>7</sup> studying the birth weights of nearly 6000 children of the Nykobing-on-Sealand district of Denmark, observed that infants born in the fall months were heavier than those born in the spring. The last observations on this subject are those of Faber<sup>8</sup>



who examined the birth-weight records of 644 San Francisco infants. His findings on the whole are negative, although he noted "considerable variation in birth weights of boy babies, while those of girl babies were curiously constant throughout the year." Thus two observers (Adersen and Hansen) working with material from a region of noticeable seasonal differences in temperature, have found considerable seasonal differences in the birth weight, while one (Faber) on studying material from a locality where the seasonal temperature changes are not great, found little or no such difference.

It would seem that an examination of the material from a locality such as Minneapolis where the annual fluctuations in mean temperature are much greater than in southern Sweden and Denmark, not to mention San Francisco, might give a definite answer to the question.

The material, which covered the years from 1915 to and through 1918, was analysed in the following manner: All data were first arranged according to years. The average birth weight for each month was then determined separately for all males, all females, all children of primiparae, all children of multiparae, and for each of the last two classes subdivided according to sex. The weight of each case was then plotted on a field graph in which body weight was the ordinate and the months of the year were the abscissae. The curve of the average monthly weight of each class was also plotted on the same graph by connecting the average monthly weight points. The curves thus established were then transferred to a second graph having a double series of ordinates, one of the body weight and one of mean temperature, the abscissae representing the months. The mean temperature curve for the State of Minnesota<sup>a</sup> for each year of observation as given by the United States Weather Bureau Reports, was then plotted on this graph and the general character of the two curves (average body weight and mean temperature) compared. This was done first separately for each year and then combinations for the entire four year period were similarly compared.

In order to reduce temperature and birth weight to a comparable basis the yearly averages of both of these values were taken as 100 percent, and the monthly averages of both were calculated as percentages

<sup>a</sup> Temperature curves were plotted from the United States Weather Bureau Reports for the State of Minnesota and were not localized to a smaller area for the reason that many of the cases reported are from outside the city and come from all parts of the state.

of these yearly ones. This was done first for each class of children and for each year, and later composite graphs were made for the four year period and for all classes of infants.

Some of the results of these procedures illustrated graphically in figures 1, 2, 3, are shown in numerical form in tables at the end of this paper.

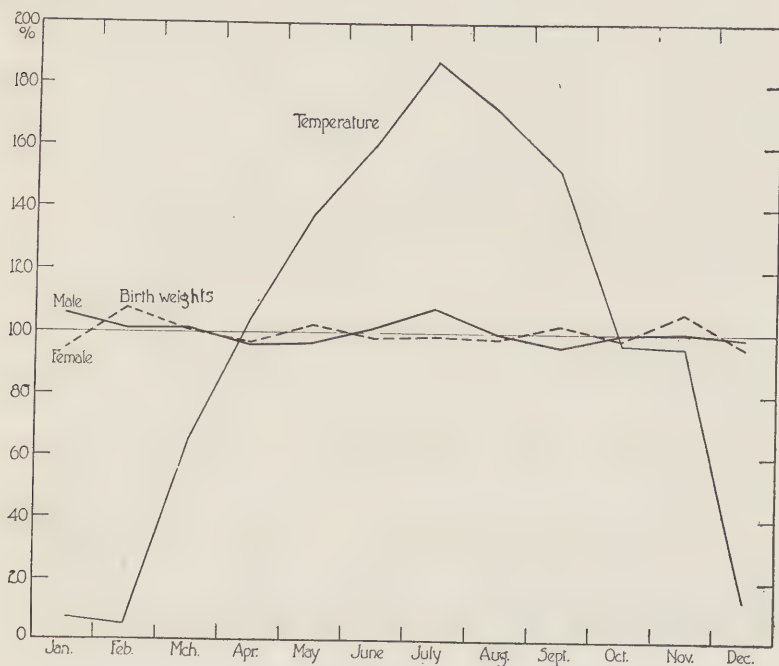


FIG. 1

FIG. 1. The broken line is the percentage birth weight curve for 330 females born in Minneapolis in 1917, and the unbroken line represents 308 males. The average weight for the females for 1917 was 3282 gm., and for males 3419 gm. These weights were each taken as 100% and the monthly variations from these were calculated as percents of the average. The temperature curve which runs through these shows the deviation in the yearly temperature in Minnesota for 1917. The mean temperature for the year was 37.73 degrees, which also was taken as 100 percent and the monthly variations calculated from this basis.

Figure 1 shows graphically the amount of percentage deviation in the yearly temperature in Minnesota for the year 1917. The average temperature for this year was found to be 37.73 degrees, which was taken as 100 percent, and the monthly variations in temperature were calculated in percentage form from this basis. The average birth weight

for 308 male children born in Minneapolis in 1917 was found to be 3419 grams and of 330 female children 3282 grams. These weights were taken as 100 percent, and the monthly variations from these were calculated in terms of percents. The monthly percentage temperature variations and the monthly percentage birth weight variations were plotted from the same 100 percent line.

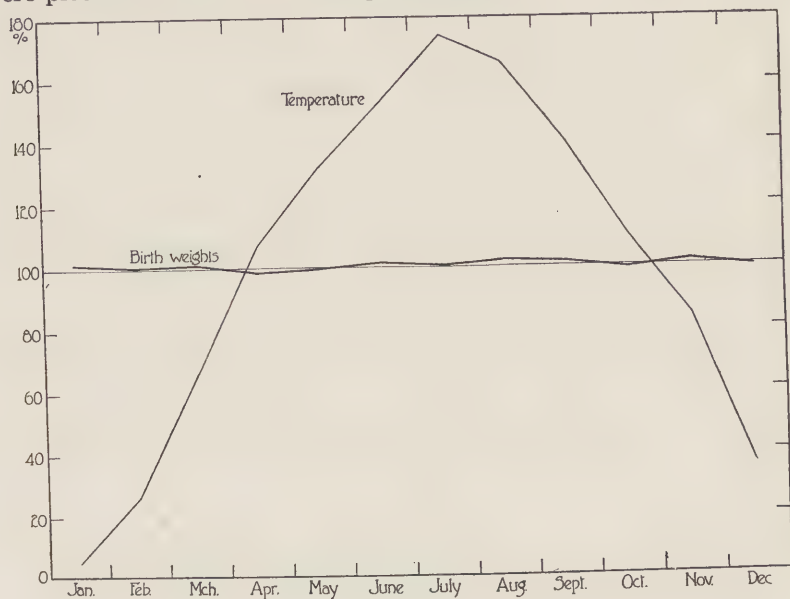


FIG. 2

FIG. 2. Similar to figure 1 but representing a composite picture for the 4 years 1915-1918. The average weight of the 1931 children was 3314 gm. which was taken as 100 percent. The average temperature for the 4 years was 40.28 degrees and also represents 100 percent.

Figure 2 is similar to figure 1 but represents a composite picture for the four years 1915 through 1918 and includes 952 males and 979 females.

Thus, in so far as the present material goes, temperature appears to have no effect on birth weight. This is at variance with the observations of Adersen and of Hansen and confirms Faber's findings for San Francisco.

It has been suggested that there exists a *seasonal* difference in birth weight which is independent of temperature. Bleyer, Camerer, Malling-Hansen and others have noted such a periodicity of growth during infancy. Bleyer gives figures to show that weight gains in the first



TABLE 1. AVERAGE MONTHLY BIRTH WEIGHTS CALCULATED IN PERCENT OF AVERAGE YEARLY BIRTH WEIGHTS

Year	FEMALE			MALE			BOTH SEXES				
	1915	1916	1917	1918	1915	1916	1917	1918	Female	Male	Both Sexes
	%	%	%	%	%	%	%	%	Percentage totals 4 yrs. averaged		
Grams	3271	3218	3288	3239	3401	3320	3419	3368	3252	3377	3314
January.....	91.1	101.6	94.7	102.8	111.7	94.9	105.6	103.6	97.5	103.9	100.7
February.....	95.7	101.6	107.2	99.4	98.8	94.3	100.0	104.2	100.8	99.3	101.1
March.....	106.1	94.8	100.5	104.0	94.1	103.0	100.9	101.5	101.4	99.9	100.5
April.....	99.4	100.1	96.6	100.9	90.6	102.4	95.9	99.8	99.2	97.2	98.2
May.....	96.3	99.1	102.7	98.8	99.9	101.5	96.5	98.6	99.2	99.1	98.2
June.....	102.1	98.8	98.7	98.8	104.4	100.9	100.0	99.8	99.6	101.3	100.4
July.....	102.7	98.2	99.3	101.9	92.3	97.0	107.6	101.8	100.5	99.7	100.1
August.....	103.3	99.4	98.7	104.9	104.1	100.3	99.7	102.7	101.3	101.7	100.5
September.....	105.2	104.1	102.0	96.0	102.0	108.6	95.3	92.0	101.8	99.8	100.7
October.....	96.6	105.6	97.8	95.4	96.1	99.2	99.2	96.5	98.9	99.5	99.1
November.....	102.7	99.4	106.6	94.5	100.9	97.9	100.0	99.8	100.8	99.6	100.2
December.....	98.7	98.2	95.0	97.2	105.0	96.9	98.3	99.8	97.3	99.9	98.6

year of life are greater in summer and fall than in winter and spring, while Camerer finds a greater gain in fall and spring than in winter and summer. Malling-Hansen divided the year into three periods of (1) minimal growth, mid April to mid July, (2) maximal growth mid July to mid December and (3) a rest period from mid December to mid April. He says the maximum weight may come at the beginning of a year if this comes at the close of a period of maximal growth and after a long period of stationary weight without pathological significance.

When the total of our percentages are grouped according to the four seasons of the year and weighted by the number of cases represented, the males of this series illustrate Malling-Hansen's theory of a period of maximum growth from mid-July to mid-December, since the highest percentage weights come at the close of this period showing 101.99 percent for winter (see table 1), while spring shows a drop 98.88 percent, perhaps to be accounted for by the rest period which ends in April. Malling-Hansen used only male children in his records.

With the figures grouped and weighted as above, the females of this series follow Camerer's findings of greater gain in fall and spring than in winter and summer (see table 2) and the male variation is seen to be greater than the female. Figures for males and females combined show higher percentage weights for summer and fall than for winter and spring which corresponds to Bleyer's weight gains in the first year of life.

TABLE 2—AVERAGE SEASONAL BIRTH WEIGHTS CALCULATED IN PERCENT OF AVERAGE YEARLY BIRTH WEIGHT

	Female	Male	Both
Winter.....	99.30	101.99	99.93
Spring.....	100.42	98.88	99.33
Summer.....	100.03	100.86	100.32
Fall.....	100.01	98.57	100.01

A question arises as to whether the small fluctuations in averages which appear at different seasons can be correlated with climatic changes and whether they are of any significance. At least a partial answer can be had by comparing table 1 with the statistics of variability of weight and length of the newborn as quoted from Harris and Benedict.<sup>13</sup>

Quetelet's series as reduced by Pearson gives the following means, in grams, and standard deviations (S. D.) with coefficients of variation (C. V.), for 63 newborn male and 56 newborn female Belgian babies:

	Mean	S. D.	C. V.
Male infants.....	$3.289 \pm 0.041$	$0.482 \pm 0.029$	$14.66 \pm 0.90$
Female infants.....	$3.053 \pm 0.048$	$0.538 \pm 0.034$	$17.62 \pm 1.16$

The Anthropometric Committee's report to the British Association for 451 boy infants and 466 girl infants follows:

	Mean	S. D.	C. V.
Male infants.....	$3.230 \pm 0.016$	$0.508 \pm 0.011$	$15.73 \pm 0.36$
Female infants.....	$3.151 \pm 0.015$	$0.480 \pm 0.011$	$15.22 \pm 0.35$

Stuttgart babies, 500 of each sex, from Elsasser, show:

	Mean	S. D.	C. V.
Male infants.....	$3.233 \pm 0.013$	$0.439 \pm 0.009$	$13.57 \pm 0.29$
Female infants.....	$3.151 \pm 0.013$	$0.418 \pm 0.009$	$13.28 \pm 0.29$

For 1000 male and 1000 female infants measured in Lambeth Lying-in Hospital, London, we find:

	Mean	S. D.	C. V.
Male infants.....	$3.312 \pm 0.011$	$0.519 \pm 0.008$	$15.664 \pm 0.242$
Female infants.....	$3.208 \pm 0.010$	$0.456 \pm 0.007$	$14.228 \pm 0.219$

Dr. Rood Taylor's series of 120 boys and 122 girls shows:

	Mean	S. D.	C. V.
Male infants.....	$3.496 \pm 0.026$	$0.419 \pm .018$	$11.99 \pm 0.53$
Female infants.....	$3.368 \pm 0.026$	$0.423 \pm .018$	$12.57 \pm 0.55$

The probable error as shown above is about 20 grams or between 0.6 and 0.7 percent of the average. It thus appears that the variations both for temperature fluctuations and for seasons of the year fall within the limits of probable error of mean weight, and it is therefore questionable whether any significance should be attached to them.

Table (1) gives the average monthly weights in terms of percentage of the yearly average. The percentage totals are weighted by the number of cases represented in each month. This gives a large number of cases proportionately more influence than a small number in the final result. In grouping the totals into winter, spring, summer and fall the results are weighted as above according to the total number of births for each of the four seasons. Wide variations from the average are usually due to a small number of cases, for example the males for January 1916 (10 cases) show an average weight of 3150 grams, whereas the larger number of cases as the males for August 1916 (30 cases) show an average of 3330 grams. The average for the year 1916 is 3320 grams. This shows that a large number of cases tend to have a smoothing effect on the general curve of the whole.



Since the above was written three series of observations from central Germany giving the average weight of the newborn by months has become available. These observations include records of over 3000 children from Baden; over 1000 taken in 1912, 1000 during 1915 and another 1000 in 1916. They were reported by Kronig and Momm.<sup>14</sup> Another series collected at Posen by Lange and Mossmer<sup>15</sup> includes 825 cases from April 1915 to May 1916 and 1093 cases from April 1913 to May 1914. A third series from Berlin reported by Bumm and Ruge<sup>16</sup> includes 2000 deliveries in 1913 and 1759 from July 1915 to June 1916. All of these data were collected in connection with studies on nutrition during the war period. Since the cases are arranged in monthly averages, it is possible to examine the material with the same methods as were used for the study of the Minneapolis data and to compare the results obtained.

The averages reported in these investigations were reduced to a percentage basis and plotted to make them comparable to the results in the writer's series. The resulting curves were of the same general type as those previously described (see Figure 1) and thus tend to confirm the statements already made that seasonal variations have no definite effect on the weight of the newborn. In fact the curves plotted from the German data more nearly approach a straight line than the curves based on the writer's observations, probably because the German material is not divided according to sex.

## II. RACIAL DIFFERENCES IN BIRTH WEIGHT

Differences in the birth weights of children of the various races and nationalities in Europe have been briefly mentioned by a number of pediatricians and obstetricians, but little attention has been paid to the weight of children of European-born parents in extra-European countries, the only important studies on the subject being those of Lane<sup>11</sup> and Robertson.<sup>12</sup>

The same material as above described was used to study the effect of race, the data being sorted out as to nationality of parents as given on the mother's hospital chart. The data from European clinics and from various portions of the United States used in comparisons were collected by Dr. R. E. Scammon.

Of 1931 cases taken over a period of four years the average weight in Minneapolis is 3315 grams. The 952 males averaged 3377 grams while the 979 females averaged 3253.5 grams. These figures from Minneapolis do not differ greatly from those collected in different parts

of the United States. For instance Meyer in Baltimore found 3390 grams for males and 3240 for females, while Holt in New York City found 3400 grams for males and 3250 for females (see table 3).<sup>b</sup>

Birth weight averages obtained in this series are much closer to the figures usually quoted in textbooks than Warren's<sup>c</sup> averages for the State of Maine. A greater constancy is observed for birth weights of the girls than for those of the boys, which again agrees with Faber's findings.

In this series 341 children of American-born parents averaged 3334 grams, while 626 children of foreign-born parents averaged 3245 grams. Here again the male variation was greater than the female. As will be seen in figure 3, the children of American-born parents lead for first place as to males, while first place is held by children of Norwegian-born parents as to females. The Jewish race bears distinctly the smallest children of both sexes. These results are opposed to those obtained by Warren<sup>10</sup> who found that the average weight of 216 infants of American-born mothers in the State of Maine was 8.3 pounds (ca. 3735 grams) while the weights of 272 infants of foreign-born mothers was 8.7 pounds (ca. 3780 grams).

The histogram in figure 3 shows graphically the birth weights of children of American-born parents as compared with children of the foreign-born, and table 3 is a comparison of the average birth weights of Minneapolis-born children of immigrant parents with the average birth weights of the same nationalities in their homelands. The names of European observers are given for each country except Germany where the list was too long to print. The latter figures come from twenty-five German clinics and represent an average of over 38,000 cases.

Figures collected in Scandinavia, Russia, and Germany by observers abroad show higher birth weights for both sexes in the respective countries than are shown by first generation of American-born children

<sup>b</sup> The high weights of Taylor's averages for Minneapolis are probably to be explained by the fact that all infants regarded as at all premature were excluded from his series.

<sup>c</sup> Warren finds in over 2000 records for the State of Maine that of his first five hundred cases, the girls weighed 8.25 pounds (3707.5 grams), the boys 8.75 pounds (3937.5 grams) with the same ratio holding true for the next thousand cases. He notes that textbooks give 7 to 7.5 pounds (3150 to 3375 grams) as average weight and comments that the heavier babies in the State of Maine may be accounted for on the bases of heredity, climate, manners and customs. It is difficult to separate the influences of racial heredity from those of manners and customs of living.

of the same nationalities in Minnesota (see table 3). This difference probably must be explained on some other basis than the one usually suggested of improved living conditions since presumably these people from the various European countries changed their homes to better

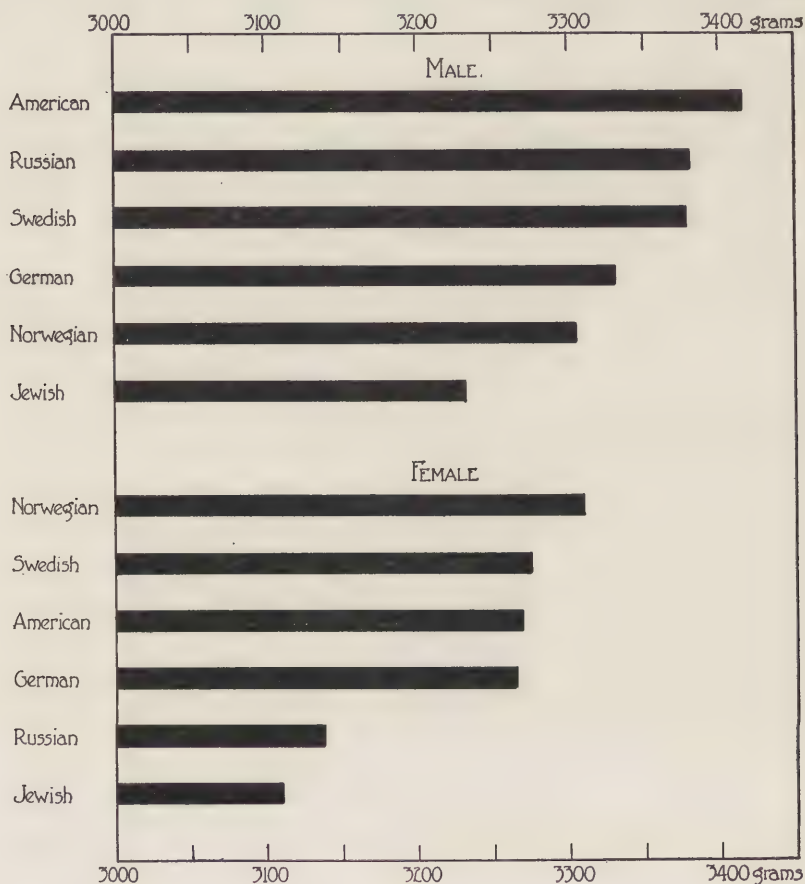


FIG. 3

FIG. 3. Comparison of the weight at birth of Minnesota children of American-born parents with Minnesota children of foreign-born parents. Sexes considered separately.

their living conditions. The female variation again is less than the male.

Thus the present findings are in marked contrast to those of Robertson<sup>12</sup> who noted a superior weight for Australian infants of British descent at birth as compared with the birth weight of infants in the



TABLE 3. COMPARISON BIRTH WEIGHTS AMERICA AND EUROPE

Parents of Minneapolis children born in	AVERAGE WEIGHT GRAMS MINNEAPOLIS CHILDREN			Author and Date European Observer	AVERAGE WEIGHT KILOGRAMS EUROPEAN CHILDREN		
	Number Cases	Male	Female		Number Cases	Male	Female
Russia.....	35	3380	3139	Fuhrmann (1907) Sadovski (1904)	1000 1015	3.49 3.44	3.18 3.30
Sweden.....	208	3378	3277	Adersen (1899) Petersen (1882)	2960 1675	3.45 3.59	3.36 3.45
Norway.....	158	3325	3310	Isachsen (1915) Kjolseth (1913)	285 553	3.58 3.60	3.53 3.45
Germany.....	102	3330	3265	25 clinics	38,143	3.34	3.25
America.....	Number Cases 341	Male 3415	Female 3272	Author and location in United States This series	Minneapolis		
		(kilograms below)					
	323	3.35	3.25	Scammon and Doyle (1920)	"		
	250	3.48	3.38	Taylor (1919)	"		
	1000	3.43	3.32	Townsend (1896)	Boston		
	1500	3.97	3.74	Warren (1917)	State of Maine		
	1000	3.40	3.26	Holt (1897)	New York City		
	597	3.35	3.15	Stockton-Hugh (1885)	Philadelphia		
	2059	3.39	3.24	Meyer (191 )	Baltimore		
	644	3.49	3.30	Faber (1920)	San Francisco		

British Isles. He infers "that the superior weight of the Australian is attributable to—the changes in climatic, social and economic conditions." He states that the climate is much less rigorous, that food is cheaper in proportion to income, and that economic conditions are improved in Australia over England. Robertson<sup>d</sup> finds the Anglo-American infant to be intermediate as regards weight at birth between the Australian white infant and the infant born in the British Isles.

### III. PARITY AS AFFECTING BIRTH WEIGHT

In studying parity, the material was divided into children of multiparae and primiparae, keeping the sexes separate, and graphs were made of each. They showed that parity, after sex, is perhaps the most potent factor in determining birth weights. In studying a series of curves for the years 1915 to 1918 the children of multiparae are pretty constantly above the primiparae as is illustrated by curves showing females for 1918.

### CONCLUSIONS

1. From data on a large group of American newborns taken from a locality showing great differences in seasonal variation in temperature, it seems that temperature has little if any effect on birth weights.

2. With all data on a percentage basis and the total percentages grouped according to the four seasons of the year and measured by the test of probable error, it seems that no direct seasonal variation (as distinct from temperature variations) exists in the weight of the newborn.

3. In the cases studied, children of American-born parents show higher birth weights than those of foreign-born.

4. Figures from observers in Europe show higher birth weights than those of first generation American-born children of the same nationalities.

5. Male variations in birth weight are in every comparison here made greater than female variations.

### BIBLIOGRAPHY

1. Malling-Hansen, 1883: Über Periodicit im Gewicht der Kinder. Kopenhagen.
2. Bleyer, A. 1917: Periodic Variation in Rate of Growth of Infants. *Arch. Pediat.*, XXXIV, 366.

<sup>d</sup> Robertson's statistics on the Anglo-American infant were taken from Bowditch in the Eighth Annual Report of the State Board of Health, Massachusetts 1877.

3. Montessori, M. 1913: Pedagogical Anthropology. Tr. fr. Ital. by F. T. Cooper, N. Y., F. A. Stokes Co.
4. Daffner, F. 1902: Das Wachstum des Menschen. Leipzig, W. Engelmann.
5. Camerer, W. 1910: Gewichts und Längenwachstum der Kinder. Pfaundler und Schlossman, *Handb. d. Kinderheilkunde*, Leipzig, Vogel.
6. Adersen, H. 1899: "Sermo de pondere et longitudine infantum recens natorum." *Nordiskt Med. Ark., N. F., X*, 24.
7. Hansen, J. H. 1913: (Researches upon the weight of Newborn Children). *Meddel. f. Anthropol. Kom.*, Kopenhagen. 109 pp.
8. Faber, H. K. 1920: Study of Growth of Infants in San Francisco with a New Form of Weight Chart. *Arch. Pediat.*, XXXVII, 244-254.
9. Scammon, R. E. 1922: On the Growth in Weight of the Human Body and its Various Parts and Organs in the Fetal Period and its Expression by Empirical Formulae. *Anat. Rec.*, XXI, 79.
10. Warren, S. P. 1917: The Average Birth Weight of Two Thousand Confinements. *Am. J. Obst.*, LXXVI, 932-936.
11. Lane, C. A. 1903: A Clinical Comparison of the Maternal Pelves and of the Fetus in Europeans, Eurasians, and Bengalis. *Lancet*, Vol. 165.
12. Robertson, T. B. 1915: A Comparison of the Weights at Birth of British Infants born in the British Isles, the U. S. A. and Australia. *Univ. Cal. Pub. in Physiol.*, IV, 207.
- 12a. ——— 1915: Studies on the Growth of Man. The Postnatal Loss of Weight in Infants and the Compensatory Overgrowth which Succeeds it. *Am. J. Physiol.*, XXXVII, 74-85.
13. Harris, J. H. and Benedict, F. G. 1919: A Biometric Study of Basal Metabolism in Man. *Pub. Carnegie Inst.*, of Washington, No. 279.
14. Kronig and Momm, 1916. Hat die eiweiss- und fettarme Nahrung einen Einfluss auf die Entwicklung der Frucht? *Zentrbl. f. Gynaek.*, XL, 545-550.
15. Lange, M. and Mossmar, 1916. Über "Kriegsneugeborene." *Zentrbl. f. Gynaek.*, XL, 684-686.
16. Bumm, E. and Ruge C., 1916. Über den Einfluss der Kriegsernährung auf Fruchtentwicklung und Laktation. *Zentrbl. f. Gynaek.*, XL.





## THE RELATION OF WEIGHT TO CHEST-GIRTH, STATURE, AND STEM-LENGTH<sup>1</sup>

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### THE PROBLEM

Chest measurement, poignantly complained Corbin in 1831,<sup>1</sup> though practised since Laennec in 1819 by many of the most justly eminent members of the Paris faculty, remained surprisingly scorned. And this in spite of the ease of its performance, compared with the experience necessary for satisfactory auscultation. The same neglect has continued for a century.

Five years ago, in an attempt to discover which of the many—and therefore obviously inadequate—weight standards was the soundest, experimental application to normals showed us<sup>2</sup> that weights predicted by the scarcely recognized formula of the Russian military surgeon Bornhardt<sup>3</sup> came nearest to the observed weights. Now this formula differed from the less accurate methods in that it utilized in addition to the height on which the others depended, the circumference of the chest.

The fundamental necessity of securing this measurement has more and more struck home to us in subsequent studies<sup>4-10</sup> of the much mooted topic of normal weight. These examinations of fact have repeatedly proven that those weight tables excel, which take notice of the perimeter of the thorax.

Full recognition however, of its primary importance has been delayed by the claim of Pirquet<sup>11</sup> that the critical measurement is the sitting-height, and by the independent but parallel insistence of Dreyer<sup>12+13</sup> on the stem-length, a nearly identical but, as we agree,<sup>14</sup> more reliable measurement aiming to reproduce the distance between the bony landmarks; Vertex and ischial tuberosities.

A still shorter section of the body length has also been fancied on theory that, if the weight be more nearly related to the body length with-

<sup>1</sup> For valuable assistance in this paper the author is indebted to Dr. Wade Wright. AMER. JOUR. PHYS. ANTHROP., Vol. V, No. 3.

out the legs (sitting-height or stem-length), it may be even more closely proportional to one of those two minus the head and neck. This torso length may be taken anteriorly from suprasternal notch to the seat, or posteriorly from vertebra prominens to seat. The former has seemed to us both untrustworthy owing to the mobility of the upper landmark during respiration, and also inconvenient to measure in women. The spine of the seventh cervical vertebra on the other hand has struck us as a more fixed point, especially with the subject placed in the stem-length position so well defined by Walker<sup>15</sup> and by Dreyer. We have therefore measured from the nuchion to the seat as representing the distance of the seventh cervical spine to ischial tuberosities. It might be called the short stem-length, and for convenience' sake will be abbreviated below as 7C.

#### METHOD OF ATTACK

In order to determine as indisputably as may be, the correlation between body weight and these rival gauges of body frame, we have undertaken the laborious method of biometric analysis. Our series is small: 80, but that is larger than several of the groups considered adequate for the far more complex problem of metabolism by such authorities as Harris and Benedict.<sup>16</sup>

The technic of biometrical figuring and interpretation may be briefly stated. Any physician venturing into this field will find today we believe no clearer exposition than Harris and Benedict's monograph, nor any more helpful manual of statistics than Yule's.<sup>17</sup> For the mechanical work a calculating machine is not necessary, but much time can be saved by using Pearson's Tables<sup>18</sup> and Henselin's *Rechentafel*.<sup>19</sup>

Two methods have been used to calculate each average, each standard deviation, each numerator for the fraction yielding the fundamental correlation coefficient  $r$ ; while the remaining arithmetical work has been checked throughout by a second person. The numerical results therefore are believed correct.

#### SUBJECTS MEASURED

The material consisted of 80 healthy men, aged 18 to 71, mostly 20 to 35. These included 36 oarsmen at the Harvard crew quarters at Red Top in 1921,<sup>20</sup> and a number of former athletes in medical school or active professional life. In short, there was little likelihood of either obesity or wasting disease.

All measurements were taken without clothes.



## RELATION OF WEIGHT TO VARIOUS BODY MEASUREMENTS

*Graphic Correlation by Semi-logarithmic Paper.*—The simplest manner of gaining some conception of the degree of correspondence between the weight and the physical measurements previously discussed, is to plot a ratio chart. For such a study of the parallelism between curves, the simple co-ordinate paper usually employed in medical articles gives an impression which is sometimes fallacious and often obscure.

In the present study, and probably more generally than realized by scientific men using statistics, greater lucidity may be obtained with a logarithmic ruling. This is at first confusing, but can be mastered in a few minutes and that without an understanding of logarithms. The resulting graph is much easier to interpret, both by maker and reader, for one needs only to know that on semi-log or arithilog paper the curves representing two variables which are increasing at the same rate tend to be parallel, no matter which curve is situated nearer the top of the diagram. In other words, during interpretation, the absolute values can be disregarded, a convenience non-existent in the case of many of the charts plotted on squared paper. Semi-log paper exhibits the customary equal divisions along the base line, while the vertical scale is divided into logarithmic spaces as on a slide rule.

Let us now sort our 80 cases serially beginning with the smallest weight, and plot these, then turn over the cards again and plot the height, chest-girth, stem-length and the seventh cervical length. In Chart 1. we notice:

1. The irregularity of all the measurement curves.
2. That parallelism to the weight curve is most striking in the case of the chest curve, while the other three seem much alike.

In order now to make the facts in Chart 1 more intelligible, each variable was averaged for each successive group of five cards, then the 16 averages were plotted, and a demarcating high and low line drawn for each variable. It so happened that each pair of these boundary lines showed such parallelism that it was easy to draw through the zone a single straight line to represent the general trend. These five trend lines are reproduced in Chart 2, from which the weight appears to be correlated to the bodily measurements in the following order: (1) Chest-girth, at nipple level, halfway between full inspiration and complete expiration. (2) Height; (3) 7-Cervical; (4) Stem.

How hazardous this interpretation may be, and how inexpressively subjective at best, will appear below.

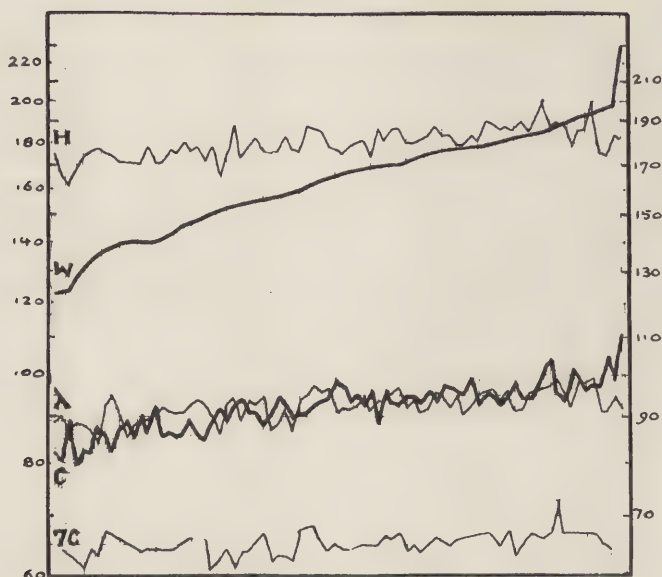


CHART 1. RELATION OF WEIGHT TO BODY MEASUREMENTS

W=Weight in pounds (log scale) of 80 normals arranged consecutively from left to right;

H=height in cm. corresponding to each W;

$\lambda$  = stem-length in cm. corresponding to each W;

C=chest-girth in cm. corresponding to each W.

7C=short stem in cm. corresponding to each W.

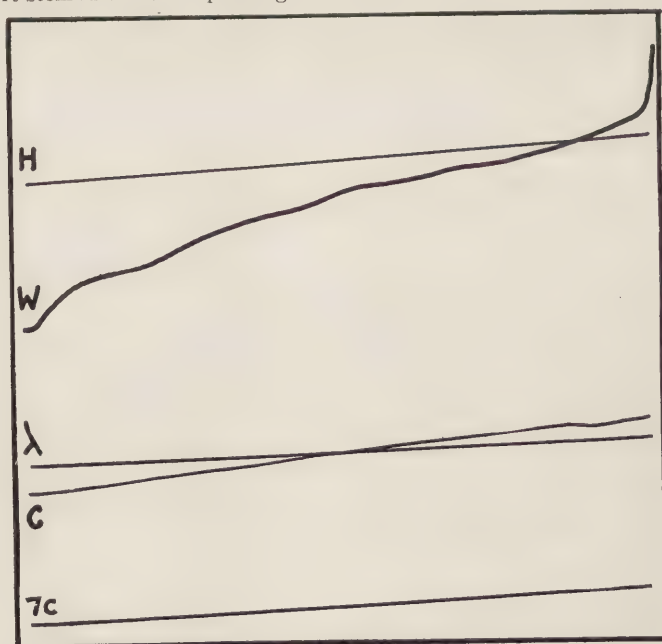


CHART 2. SMOOTHING OF THE CURVES FOR BODY MEASUREMENTS SHOWN IN CHART 1.

*Numerical Correlation by the Coefficient  $r$ .*—This basic value is shown with other usual statistical constants in Table 1.

TABLE 1—STATISTICAL CONSTANTS

MEASUREMENTS	MEAN	STANDARD DEVIATION	VARIABILITY	COEFFICIENT OF CORRELATION
N=80	M $\pm$ p.e.	$\sigma$ $\pm$ p.e.	V	$r_{wx}$ $\pm$ p.e.
Weight W	163.3750 $\pm$ 1.575	20.89 $\pm$ 1.114	12.79	
Chest-girth C	92.2563 $\pm$ 0.4429	5.873 $\pm$ 0.3131	6.37	+0.879 $\pm$ 0.0172
Height H	179.4250 $\pm$ 0.5636	7.474 $\pm$ 0.3985	4.17	+0.639 $\pm$ 0.0446
Stem $\lambda$	92.5063 $\pm$ 0.2587	3.430 $\pm$ 0.1829	3.71	+0.575 $\pm$ 0.0505
Short stem 7C	65.0689 $\pm$ 0.1899	2.144 $\pm$ 0.1343	3.29	+0.440 $\pm$ 0.0714

The inference from these coefficients of correlation is plain at a glance when we remember that the nearer  $r$  is to unity, the greater the interdependence of the two variables considered. A trained statistician might state mathematically the significance to be attributed to the differences between the four coefficients of correlation, but the following general deduction is believed to be for our purposes adequate and true.

The weight of adults is most nearly related to (1) chest-girth, next best to (2) height, then (3) stem-length and least to (4) 7-Cervical length. The first two of these therefore should be taken into account in constructing a normal weight standard.

Davenport and Love in 1921, reported for U. S. Soldiers at demobilization, a much less striking figure:  $r_{WC}$  (deflated chest at nipple level) = 0.6598, but it definitely exceeded the  $r_{WH}$  which was 0.4810 and the principle they deduced is harmonious with ours. They wrote: "This indicates that the development of muscles and the deposition of fat upon the chest go hand in hand with increasing weight, so that the two are closely interdependent. . . . The weight and chest circumference (expiration) are more closely correlated measurements than are the stature and weight." These statements, none the less, they seem unwilling to accept at their face value for they end with "the conclusion that in accordance with the findings of Gould, and before him, Quetelet, the ratio of weight divided by the second power of the height seems to be the most satisfactory index of build."

For boys from 7-16 years, similar laws may be seen in the coefficients published by Baldwin in 1921,<sup>22</sup> which afford most satisfactory confirmation of the tenets demonstrated in the paper, and seem strong evidence that they hold true for children as well as for adults. He found:



$r_{WC}=0.859$  (compared with our 0.879),

$r_{WH}=0.809$  (compared with our 0.639),

$r_{WSi}=0.785$  (compared with our 0.575 for  $r_{W\lambda}$ ).

His comment however was brief: "Between the yearly measurements of weight and the girth of the chest the correlations are higher than for weight and any other physical trait measured. The coefficients are fairly uniform throughout the ten years."

#### SUMMARY

Indirect evidence has increasingly impressed upon us the close connection between weight in man and the thoracic girth, together with uncertainty as to the next best measurement.

Direct biometric data have therefore been sought in the literature and determined from personal observations on 80 unusually fit men. From these facts we deduce the principles that the weight is correlated with the physical measurements in the following order:

(1) Chest-girth, taken as the mean between full inhalation and complete exhalation at mammillary level.

(2) Height.

(3) Stem-length.

(4) Short stem-length, or distance 7-cervical spine to seat.

Application of these principles to the construction of a practical weight standard will be suggested in a subsequent paper.

#### REFERENCES

1. Corbin (E.)—Instruction pratique sur les diverses méthodes d'exploration. Paris, 1831.
2. Gray (H.) & K. M. Gray—Normal Weight. *Bost. Med. & Surg. J.*, Dec. 27, 1917, CLXXVII, 894.
3. Bornhardt (A.)—Die Körperwägungen der Einberufenen als Mittel zur Bestimmung der Tauglichkeit zum Militärdienst. *St. Petersb. med. Wchschr.*, 22 March (3 April) 1886, N. S. III, 108, and 24 May (5 June) 1886, N. S. III, 196. do.—Über die Bezeichnung der Körperbeschaffenheit durch Ziffern. *Ibid.*, 26 November (8 Dec.), 1888, N. S. V, 413.
4. Gray (H.) & J. F. Mayall—Body Weight in 229 Adults; Which Standard is the Best. *Arch. Int. Med.*, Aug. 1920, XXVI, 133.
5. Gray (H.) & H. F. Root—Weight Prediction by the Formulae of Bornhardt, of Von Pirquet and of Dreyer. *Bost. Med. & Surg. J.*, July 7, 1921, CLXXXV, 28.
6. Gray (H.)—Size and Weight in 130 Boarding School Boys (Middlesex). *Med. Clinics No. Amer.*, May 1921, IV, 1899.
7. Gray (H.) & W. J. Jacomb—Size and Weight in 136 Boarding School Boys (Groton). *Am. J. Dis. Child.*, Sept. 1921, XXII, 259.
8. Gray (H.)—Ideal Tables for Size and Weight of Private School Boys. *Ibid.* 272.

9. Gray (H.) & A. M. Walker—Length and Weight. *Am. J. Phys. Anthropol.*, July-Sept. 1921, IV, 231.
10. Gray (H.) & G. H. Edmands—Indices of the State of Nutrition in Children. *Am. J. Dis. Child.*, March, 1922, XXIII, 226.
11. Pirquet (C.)—Sitzhöhe und Körpergewicht. System der Ernährung II. *Z. f. Kinderheilk.*, 1916, XIV, 211.
12. Dreyer (G.)—Investigations on the Normal Vital Capacity in Man and its Relation to the Size of the Body. *Lancet*, Aug. 9, 1919, II, 227.
13. Dreyer (G.) & G. F. Hanson—The Assessment of Physical Fitness. London, 1920; repr. N. Y., 1921.
14. Gray (H.)—Sitting-height and Stem-length in Private School Boys. *Am. J. Dis. Child.* May, 1922, XXIII, 406.
15. Walker (E. W. A.)—The Growth of the Body in Man; The Relationship between the Body Weight and the Body Length. *Proc. R. Soc. Lond.*, Jan. 1, 1916, LXXXIX, 157.
16. Harris (J. A.) & F. G. Benedict—A Biometric Study of Basal Metabolism in Man. *Pub. No. 279*, Carneg. Inst., Wash., 1919.
17. Yule (G. U.)—Introduction to the Theory of Statistics. 5th ed., Lond., 1919.
18. Pearson (K.), Editor—Tables for Statisticians and Biometricians. *Cambridge Univ. Press*, 1914.
19. Henselin (A.)—Rechentafel. Berlin, 1912.
20. For these measurements we are greatly obliged to Dr. George P. Denny.
21. Davenport (C. B.) & A. G. Love—Army Anthropometry. Publ. by the *Med. Dept.*, U. S. Army, Wash., 1921, 260, 175, 163.
22. Baldwin (B. T.)—Physical Growth of Children. 8°, Iowa City, 1921, 120, 124.





## THE DISTRIBUTION OF BODY HAIR IN WHITE SUBJECTS<sup>1</sup>

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The desirability of a comparative study of the hairiness of the body as a whole was suggested by Waldeyer and has been emphasized by a number of subsequent writers. Nevertheless, practically all work relating to the anthropology of hair has been confined to studies on the hair of the head. Satisfactory methods for the study and description of hair in regions where it is relatively sparse have not been developed, and until such methods are perfected accounts of body hair will necessarily be of a more or less preliminary character. Much of the material which we are able to present at this time was collected incidentally in connection with other work and partakes of some of the deficiencies just mentioned. It is reported, and discussed briefly, in order to call attention to one or two problems in methodology and interpretation.

The material in question consists of notes on several thousand soldiers made at the time of their demobilization at Camp Dix in 1919, and the records from an examination of 350 college women, together with some observations on the families of clinic patients.

For the use of the data on soldiers we are indebted to the Office of the Surgeon General of the Army. The observations on the demobilized soldiers were made by the senior author and by a few carefully instructed assistants. The women were all examined by the junior author. Both groups represent individuals of about the same age, mostly from 18 to 24 years. Some of the clinic patients were older.

The method of examination at the demobilization camp may be briefly described. When the subject came to the section for anthropometric measurement a general inspection was made of the hair of the whole body, keeping the subject in as favorable a light as possible. Five grades of body pilosity were arbitrarily established and each subject examined was recorded as belonging to group 0, 1, 2, 3 or 4 depending on the estimated amount of hair on the body. Grade 0 was constituted to cover the condition in which the distribution of terminal

<sup>1</sup> This work was undertaken in connection with a special investigation of hypertrichosis being carried on at Washington University School of Medicine.

hair on the trunk was confined to the pubic and axillary regions or to these and the hypogastric region with no hairs apparent on the chest. In Grade 1, terminal hair was obviously present in the center of the chest or about the nipples. Grade 2 included individuals with a considerable area of hair on the chest and breasts but with no marked extension over the shoulders or back (except occasionally in the lumbar region). In Grade 3 the hair was conspicuously present and abundant over the greater part of the abdomen, chest and shoulders and to some extent over the back. Grade 4 included the few cases in which the body hairiness was very extreme. Increase in the amount of hair does not always follow in the exact sequence indicated in these progressive grades, although there is a strong tendency for it to do so. While the classification of the subjects involved the formation of an estimate rather than a quantitative measure of the amount of hair in each case the conditions for making this estimate were exceptionally favorable.

In the routine official examination made at the time, the color of the hair on the head was recorded and also information bearing on the race of the individual. These data are brought together with the notes on pilosity of the trunk and included in the accompanying tabulation.

In the examination of the women only two grades of pilosity were employed. In the case of the college women the thoracic and abdominal segments were inspected both in front and behind. Here grade 0 means that, with the exception of pubic and axillary hair, there was no well developed hair on the body, but only the fine downy covering which is generally considered to be normal. Grade 1 includes all those individuals who had terminal hairs in any other region or regions than the axillary and pubic, as for example around the umbilicus, in the center of the chest, around the nipples, or on the back. The examination made on the third group, the clinic patients and their families, consisted only in differentiating between downy and terminal hairs around the nipples and in the center of the chest. In all of these examinations the greater conspicuousness of dark hair was kept constantly in mind and care was taken to avoid any resultant errors.

Table 1 summarizes the data gotten from the demobilized soldiers. The card employed for anthropometric records provided for six grades of hair color. In Table 1 these are grouped as follows: *Light* in the table includes "flaxen" and "light brown" of the record card; *Medium*, corresponds to "medium brown" and "clear red," and *Dark* to "dark brown" and "red and black." The grades of pilosity entered as 2, 3 and 4 are all grouped together, since their total numbers are small. They

represent a little over nine percent of the total and have a relative incidence of 17 : 7 : 1. The different race groups are indicated according to the designations in the records. Only those with over 100 representatives in the data available to us are recorded in this table. The figures on college women are presented in Table II.

TABLE I. BODY PILOSITY IN WHITE MEN. (DEMobilized SOLDIERS.)

Parentage	Hair Color	Grade of body pilosity			Total
Both parents born in United States		0	1	2, 3, 4	
	Light	125	879	108	1112
	Per cent	11	79	10	
	Medium	73	433	40	546
	Percent	13	79	8	
	Dark	177	1833	228	2238
	Percent	8	81	11	
Neither parent born in United States					
English Protestants					
	Light	16	49	2	67
	Percent	24	73	3	
	Medium	2	31	2	35
	Percent	6	88	6	
	Dark	18	165	12	195
	Percent	9	84	7	
Irish Catholics					
	Light	23	131	19	173
	Percent	13	75	12	
	Medium	12	98	10	120
	Percent	10	81	9	
	Dark	42	563	57	662
	Percent	6	85	9	
Irish or Scotch Protestants					
	Light	6	51	3	60
	Percent	10	85	5	
	Medium	3	12	2	17
	Percent	17	71	12	
	Dark	6	105	8	119
	Percent	5	88	7	
German Protestants					
	Light	21	161	6	188
	Percent	11	85	4	
	Medium	3	48	3	54
	Percent	6	88	6	
	Dark	17	233	8	258
	Percent	7	90	3	
German Catholics					
	Light	17	76	5	98
	Percent	17	77	6	
	Medium	5	29	1	35
	Percent	14	82	4	



Parentage	Hair Color	Grade of body pilosity			Total
Austrian Catholics	Dark	14	33	5	52
	Percent	9	86	5	
	Light	4	22	2	28
	Percent	14	78	8	
	Medium	1	9	1	11
	Percent	9	82	9	
Polish Catholics	Dark	8	54	5	67
	Percent	11	80	9	
	Light	13	90	5	108
	Percent	12	83	5	
	Medium	3	35	2	40
	Percent	8	87	5	
Russian Jews	Dark	5	108	8	121
	Percent	4	89	7	
	Light	0	16	5	21
	Percent	0	76	24	
	Medium	0	13	1	14
	Percent	0	92	8	
Russian Catholics	Dark	6	160	33	199
	Percent	3	80	17	
	Light	6	30	3	39
	Percent	15	77	8	
	Medium	2	18	0	20
	Percent	10	90	0	
French or Belgians	Dark	9	40	4	53
	Percent	17	75	8	
	Light	3	16	0	19
	Percent	16	84	0	
	Medium	0	9	1	10
	Percent	0	90	10	
From Italian Provinces	Dark	4	62	10	76
	Percent	5	81	14	
	Light	2	29	3	34
	Percent	6	85	9	
	Medium	1	23	3	27
	Percent	3	85	12	
Scandinavian	Dark	22	526	102	650
	Percent	3	81	16	
	Light	11	111	7	129
	Percent	9	86	5	
	Medium	3	59	4	66
	Percent	4	89	7	
	Dark	14	65	3	82
	Percent	17	79	4	

Several questions arise on examining these tables. Do they indicate any racial differences or any differences of type? Can the data for men and women be correlated? How satisfactory and reliable is the classification? Considering the last point first, there are, as already indicated, chances for individual bias to show and also there is the danger that light terminal hairs were overlooked more often than dark ones. Careful measurements which the junior author made on facial hairs from a considerable series of women showed that estimation of the amount of terminal hair, even when conditions are favorable, may be by no means accurate. The slightly more glabrous condition indicated for soldiers with light hair (as shown in Table I) might possibly arouse a suspicion of error in recording. In view of previous study of facial hair we should have inclined to this suspicion had it not been for the fact that the data for women show a still more marked correlation between the color of head hair and the amount of body hair. When this apparent (and unexpected) correlation was noticed it was still possible to reexamine a number of the women subjects. Such reexamination, so far as it was carried out, only verified the original figures. The total number of women is rather small but the differences are large enough to appear significant. We must consequently admit that the evidence, so far as it goes, indicates that individuals with dark hair on the head are, on the whole, inclined to have more terminal hair on the body than do lighter haired subjects.

TABLE II. BODY PILOSITY IN COLLEGE WOMEN

Hair Color	Grade of body pilosity		Total
	0	1	
Light	82	24	104
Percent	77	23	
Medium	97	47	144
Percent	70	30	
Dark	49	51	100
Percent	49	51	—
Total			350

We may now inquire whether this apparent difference in the amount of terminal hair on the body is related to race or to types within the race. Table I shows some of each grade of hair color under all "races" considered, but in most cases the numbers are not sufficient to be really significant. If the association between hair color and amount of body hair is not a causal one, comparison of similarly pigmented individuals of different races should show whether the differences are racial or not.

While it is quite possible that blond Italians, for example, are of prevailing Nordic ancestry and that brunet Scandinavians have descended from Mediterranean stock, still the mixtures with native strains should tend to break up any grouping of traits which have no necessary interdependence. From this point of view a comparison of the blond and medium haired Italians with the blond and medium haired Scandinavians and Poles is of interest. The numbers are unfortunately small, but the light Scandinavians and Poles show about 9% with no excess body hair while the correspondingly pigmented Italians show only 5%. The number classed as grade 1 in body hairiness is essentially the same in both groups but the light Italians show nearly twice as many graded 2, 3 and 4. This is suggestive of a true racial difference independent of pigmentation but it is in no sense conclusive.

Another point of interest is a comparison of body hair in men and women. Tables I and II do not correspond at all. Two possible explanations of the discrepancy present themselves; the two sexes may not be comparable when it comes to variation in body hair, or the method of grouping may be faulty.

The possibility that the two sexes are really not to be compared with reference to terminal hair, that the stimulus for its development is different in the male and the female, leads to a consideration of endocrine relations and can not be profitably discussed in this connection. Bearing on the other alternative, a possible faulty basis of classification, we happen to have observations on an additional 436 soldiers not included in Table I. These were classified on a slightly different basis, grade 0 in this case including individuals with well developed hypogastric hair and a very few hairs on the chest. The figures are shown in table III. Comparing Tables II and III, the number graded as 0 is seen to be 58% for the men and 65% for the women.

TABLE III. BODY PILOSITY IN MEN (DEMOBILIZED SOLDIERS).  
(Revised Classification)

Hair Color	Grade of Pilosity			Total
	0	1	2-3	
Light	55	16	10	81
Medium	94	37	17	148
Dark	106	52	49	207
Totals	<u>225</u>	<u>105</u>	<u>76</u>	<u>436</u>

For grade 1 and over, the corresponding percentages are 42 and 35. This is not a good agreement but it is much closer and suggests that the



natural division between the lowest and next higher grade of pilosity in man is not that which was arbitrarily established for taking most of the data on soldiers. In the light of all the data now available it is rather more probable that over half of the individuals of each sex are included by a group in which the women have no terminal hair on the body (exclusive of the axillae and pubes) and the men have as a maximum well developed hypogastric hair and a very moderate amount on the chest and about the areolae. Hair in excess of this may be considered as hypertrichosis provided it is understood that the term carries no implication of pathological involvement.

The solution of the question as to the nature of these sex differences in the percentage of types will probably be reached most directly through an adequate study of heredity. A few observations from clinic patients are included in Table IV, which shows that there is at least some cor-

TABLE IV. FAMILIES OF CLINIC PATIENTS (WOMEN ONLY)

MOTHERS		DAUGHTERS	
Grade of Pilosity	Number	Grade of Pilosity	
		0	1
0	162	259	63
		Percent 80	Percent 20
1	38	33	33
		Percent 50	Percent 50

relation between the amounts of body hair in mothers and daughters.

In conclusion, we would like to point out that the figures that we are able to present suggest several interesting lines of inquiry with reference to differences in body hairiness associated with race, physical type and sex. They also make very apparent the need of a more precise method of examination and a new scheme of classification.



## SOME NOTES ON AN ESKIMO SKELETON

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Over a year ago I obtained certain parts of an Eskimo skeleton from the west coast of Hudson Bay, in fact from the left bank of the Churchill River about four miles above that desolate and once almost impregnable stronghold, Fort Prince of Wales, which despite its forty cannon "surrendered at discretion" in the year 1782 to La Perouse. (1) The parts of the skeleton in question are the complete skull together with a scapula, clavicle, humerus, radius, ulna, carpal navicular bone, and femur, all of which are of the right side. These present a certain combination of pathological features which, so far as I know, have not been described before in the Eskimo.

There is, a little further up the river, a post belonging to the Hudson's Bay Company. To it from time to time the Eskimos from the north bring down their furs; but the territory itself is in the possession of the Chipewyan Indians. The Indians of this neighborhood differ absolutely from the Eskimo in their method of disposing of their dead, for while these Chipewyan inter theirs, the Eskimo do not, but rather leave them on the surface of the ground, protected commonly from the attack of wild animals by a covering of ice or of stones. These bones are part of a skeleton which lay extended on the surface of the ground with two long poles covering it, apparently to protect it from the weight of a cairn of heavy stones which was piled over it. It is from such or from similar stone mounds that some of the remains described by Hrdlička (2) and by Brierly and Parsons (3) were collected. Undoubtedly the entire skeleton lay buried here and it is unfortunate that the bones named above were the only ones which were recovered. That they had belonged to one who had not been dead for more than a year or two is probable from the fact that the cranial cavity still contained some brain substance and that a slight amount of flesh still adhered to all the bones.

One of the exacting domestic duties of Eskimo children and of the females of all ages is the chewing and biting of the skin of the hairy seal in order to render it supple and pliable that it may be worn as



garments. This, no doubt, and similar reasons for excessive use of the jaws, obscure occasionally the customary differentiation of male from female skull. (4) In this particular skeleton the pronounced supraorbital ridges, the very square chin and the rather massive femur suggest the male sex, and though the bones of the upper limb are disproportionately slender, this may be accounted for by disuse, occasioned by disease in the adjacent elbow joint. The disappearance of the epiphyseal cartilages and the degree of wear of the teeth prove it to be that of an adult; the synostosis of the interparietal suture, which is almost complete, points to at least middle age.

It is in connection with the bones of the upper limb, which show the usual eskimoid proportions, that the first point of interest arises, for the articular surfaces which take part in the elbow joint, show advanced osteo-arthritic changes. The surfaces of contact between the humerus and the radius are markedly eburnated and the articular margins (humeral, radial and ulnar) of the joint are fringed with "candle grease droppings."

Turning to the skull, one finds that it presents the features which are characteristic of this race, being scaphocephalic, having the facial aspect of the maxilla flat, having the lower border of the zygomatic process of the maxilla at its point of articulation with the malar bone buttressed by a tubercle and in having its lateral pterygoid plate so broad that it fails by only three of four mm. to fuse with the spinous process of the sphenoid. The glenoid cavity is deep, unlike that described by Knowles. (6) The ramus of the mandible is broad, its sigmoid cavity shallow, and the torus well marked. The nasal orifice is long and very narrow. Clearly it is an Eskimo skull and with a biparietal—bizygomatic index of 102.9—probably of a full-blooded one at that. (7, 8.)

Coming next to the teeth, we find several features of interest. Certain of them are missing, the absent incisors and canines have no doubt dropped out in the handling of the specimen, but from the degree of alveolar absorption that has taken place, it is evident that the right central incisor, the second, and third, right and left lower molars and the right upper second premolar have long been lost through disease. The remaining teeth are moderately well worn and bevelled and some are very badly chipped, but there is no suggestion of dental caries, and a formation of secondary dentine is evidently protecting the pulp cavity. If the teeth are healthy, with their sockets it is otherwise, for the ravages of pyorrhea alveolaris and of resultant alveolar

abscess formation are only too apparent. One would note especially that one abscess cavity, involving the socket for the palatine root of the first right upper molar, has erupted into the maxillary antrum and communicates with it by means of a round hole, 7.0 mm. in diameter.

It is generally supposed that prehistoric man was not affected by dental caries and that the same is true of primitive peoples in our own day. Thus, Fallaize (9) speaking of the recently discovered Rhodesian remains, states that "in addition to the traces of abscesses, caries is present in the teeth themselves. This is a condition not hitherto found in any primitive skull." Moreover, the La Chapelle Skull is not free from suspicion. Keith (10) observes that "caries of the teeth was a rare disease in England until the period of the Roman occupation." Parsons commenting on 16 Eskimo crania he examined (3) remarks "Almost all the teeth left in their sockets are much worn, reminding one of those of mediaeval Englishmen; like these too, they are very free from decay. Where the teeth have fallen out, the sockets show that they were probably in good condition." Hrdlička in his exhaustive paper (2) states that in a series of 210 Eskimo skulls from various localities, in the United States National Museum collection, only three show traces of caries, two in one tooth each and one in two teeth; and speaking of his 14 Southampton Skulls, he notes "As to pathology, there is not the slightest trace of caries, nevertheless some teeth were lost in life. In the majority of these instances there are more or less signs of suppuration about the roots of the lost teeth." The observations made by Stefansson during his travels in the Arctic lend support to these conclusions. (11.)

It is therefore doubtful if the present findings contribute anything of moment in regard to this question, except that in so far as I am aware, direct infection of the antrum by extension from a tooth socket has not previously been noted in the Eskimo; nor in fact, have I found evidence of the co-existence of pyorrhoea and osteoarthritis. The only reference I find to rheumatoid conditions amongst the bones of these people is in an article by Hrdlička (2) which notes that of four Eskimos who were brought from Smith Sound to New York and who died there, the humeri "of the old man as well as of those of his wife show marginal exostoses and some wearing off of the articular surfaces at the lower end." The radii and ulnae also showed exostoses "allied to those that were observed on the humeri." "Neither the tibiae nor the femora show anything pathological, and the same is true of the fibulae." The

vertebrae were similarly involved, but "there is no trace of any disease of the teeth."

It is now well known that osteoarthritis, dental caries and alveolar abscesses have been common in Egypt and in Nubia even from pre-dynastic times, sometimes occurring together and at other times not. (15.) The excellent plates which accompany the various papers by Ruffer on Egypt (12, 13, 14, 15,) demonstrate this in a most striking manner. Further they make it clear that these diseases were often very advanced. One plate, it is true, illustrates a perforation into the antrum, but it is expressly stated that this must have been made after death. One mention only is made of an antral perforation occurring during life, and curiously enough it was bi-lateral. It occurred in an old woman from the Third Dynasty cemetery at Tourah "who had upper teeth worn down to stumps and on each side a huge hole near the site of the first molar, communicating with the antrum." These involvements of the antra were occasioned by alveolar abscesses, and the old woman had extensive disease of her bones in other parts of her body, probably secondary to these.

This, then, is the closest parallel to the case of the Eskimo, described herewith, that I have thus far come across. That his antrum was infected through a direct extension of disease from the tooth socket, there can be little doubt, and in these days when one hears so much of "Focal Infection" it is permissible to regard the disease of the joints as in all probability a sequel to the alveolar and antral involvement.

#### REFERENCES

1. Bell (C. N.)—Our Northern Waters. A report presented to the Winnipeg Board of Trade, regarding the Hudson's Bay and Strait, 1884.
2. Hrdlička (Aleš)—Contribution to the Anthropology of Central and Smith Sound Eskimo. *Bull. Amer. Mus. Nat. Hist.*, 1910, V, Part 11.
3. Brierly (J.)—and Parsons (F. G.)—Notes on a collection of Ancient Eskimo skulls. *J. Anthropol. Inst.*, 1906, XXXVI.
4. Hrdlička (Aleš)—Anthropometry, 1920, 91.
5. Duckworth (W. L. H.)—Studies in Anthropology.
6. Knowles (F. H. S.)—The Glenoid Fossa in the Skull of the Eskimo. *Mus. Bull. Dept. Mines, Canada*, 1915, No. 9.
7. Boas (Franz)—*Bull. Amer. Mus. Nat. Hist.*, 1901, XIV, Art. VI.
8. Jenks (A. E.)—Indian-White Amalgamation. *Studies in the Social Sciences*, Univ. of Minnesota, 1916, No. 6.
9. Fallaize (E. N.)—The Rhodesian Skull and the Antiquity of Man. *Discovery*, Jan., 1922.
10. Keith (Sir Arthur)—On the Broken Hill Skull. *The Illus. London News*, Nov. 19, 1921.



11. Stefansson (V.)—The Friendly Arctic. 1922.
12. Ruffer (Sir Marc A.)—Studies in the Palaeopathology of Egypt. *Univ. Chicago Press*, 1921.
13. Do. On Osseous Lesions in Ancient Egyptians. *J. Path. & Bact.*, 1912, XVI.
14. Do. Arthritis Deformans and Spondylitis in Ancient Egypt. *J. Path. & Bact.*, 1918, XXII.
15. Do. Study of Abnormalities and Pathology of Ancient Egyptian Teeth. *Amer. J. Phys. Anthropol.*, 1920, III.



## APPLICATION OF THE NASO-ORBITO-ALVEOLAR CRANIOMETRIC METHOD TO THE RHODESIAN SKULL

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In Vol. III, Part I of this Journal the writer<sup>5</sup> described a new craniometric method for application to the *norma frontalis* of the skull, termed the naso-orbito-alveolar index. He found that this new index divided modern mankind into two great groups, the Eurasiatic and Negro races. It was therefore felt that its application to the recently discovered Rhodesian skull might possibly provide some interesting as well as instructive results.

Since the skull arrived in England last autumn it has been the subject of preliminary reports by Smith Woodward,<sup>1</sup> Sir Arthur Keith,<sup>2</sup> and Elliot Smith<sup>3 & 4</sup> and many excellent photographs\* have been published. These observers are all agreed that it conforms to the Neanderthal type. It was therefore very satisfactory to the writer to find that his recently devised naso-orbito-alveolar index confirmed these conclusions. Thus it may be noted that the three rectangles in Fig. 1 exhibit an exceptional width, and in that respect, as well as in other features, agree with those in the La Chapelle skull, as figured by the writer on page 73 of Vol. III of this Journal.

On comparing Fig. 1 with Figs. 2 and 3, it will be observed that the nasal width of the Rhodesian skull conforms to that of the modern negro type of skull, and is, on the other hand, in striking contrast to the comparatively narrow nasal aperture of the European type of cranium. This impression is confirmed by estimating the nasal index of the Rhodesian skull which in the photograph yielded a result of approximately 54, thus conforming to the platyrrhine type of the negro skull of today. Of course it is obvious that this index would require to be estimated on the skull itself in order to yield an accurate result.

\*The photo utilised was that of the *norma frontalis* figured on page 682 of the Illustrated London News, November 19th, 1921.



One very striking feature of the facial aspect of the Rhodesian skull is the extreme width between the orbits. In this respect, again, it conforms to the modern negro type (Fig. 2), and both are in marked contrast to the European cranium exhibited in Fig. 3. This point appeared to the writer to be of such supreme importance, that he decided to put it to the test in the collection of crania at his disposal. As a result he ascertained that nasal width and interorbital width were evidently concomitant features. Still, it is possible that this statement may not be universally applicable. However, it is suggestive.

One of the most remarkable attributes of the Rhodesian skull is the snout-like elongation of the premaxillary portion of the upper jaw. This in the estimation of the author is one of its most primitive characters, and places the skull in a very low category. This point is worthy of further elaboration, but as it is outside the scope of the present communication, this passing reference will have to suffice. The writer must, however, direct attention to its effect in increasing the height of the lowermost rectangle in Fig. 1, thus providing one more feature of correspondence with the same rectangle of the La Chapelle skull referred to above. The close resemblance of the three rectangles of the naso-orbito-alveolar index in these two crania is certainly very suggestive and compelling.

Further, on comparing Figs. 1 and 2, it is seen that the upper and middle rectangles closely correspond in the two cases, and both crania are in this respect in vivid contrast to the corresponding rectangles (particularly the uppermost) in the European type (Fig. 3). On the other hand, one very pronounced difference between Figs. 1 and 2 is the marked diminution in the height of the lowermost rectangle in the modern negro type of skull. The outcome of these observations is, that the Neanderthal type of cranium agrees with the modern negro type in regard to the upper and middle rectangles, but exhibits a striking difference in regard to the lowermost one. The writer can find no modern skull that conforms to this latter feature, and he can therefore only repeat what he stated in a previous communication,<sup>6</sup> namely—"the Neanderthal-Mousterian type of skull is one that does not exist at the present day."

#### LITERATURE

1. Woodward (A. S.)—The Broken Hill Skull. *Illust. Lond. News*, Nov. 19th, 1921, 682.
2. Keith (Sir Arthur)—The Broken Hill Skull, *Illust. Lond. News*, Nov. 19th, 1921, 686.

3. Smith (G. E.)—The Rhodesian Skull. *Brit. Med. J.*, Feb. 4th, 1922, 197.
4. Smith (G. E.)—The Fossil Man of Rhodesia. *Atlantic Monthly*, April 1922, 454.
5. Cameron (John)—The Naso-orbito-alveolar Index. *Am. J. Phys. Anthropol.*, 1920, III. 63.
6. Do.—op. cit. p. 74.

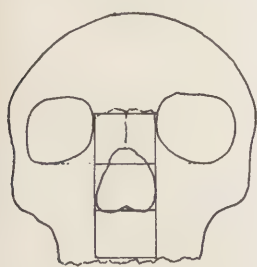


Fig. 1. Rhodesian Man

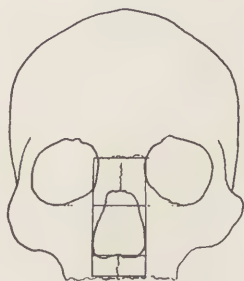


Fig. 2. Melanesian

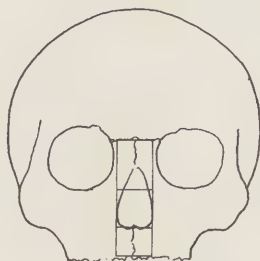


Fig. 3. European

The naso-orbito-alveolar index applied to the Rhodesian skull which is thus compared with modern Melanesian and European types. The skulls are not drawn to the same scale.





## A SLIDE RULE FOR COMPUTING AND CONVERTING CHINESE DATES AND AGES

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As an outcome of recent anthropometric studies on several hundred Chinese students involving the computation of their ages from data based on the Chinese calendar, a simple and rapid method was worked out utilizing the principle of the common slide rule. A special rule was made consisting of two scales, an upper and a lower, upon which the corresponding Julian and the Chinese calendar years and months respectively were marked; and between which a sliding scale operated. The major calibrations on the sliding scale in the centre were also in terms of years and numbered from zero to the number of years included in the entire length of the rule. A sliding marker consisting of a square piece of thin glass fastened in a light metal frame and carrying a fine vertically ruled line completed the equipment of the rule.

The principle underlying the operation of the rule in computing ages consists simply in subtracting in terms of years the distance between two fixed dates. The two dates in question are located on either the upper or lower scales, according to whether the information at hand is in terms of the "foreign" or Chinese calendar and the centre sliding scale is moved so that the zero mark coincides with one of the dates. By setting the glass sliding marker at the other of the two dates the intervening distance may be quickly and accurately noted. In as much as the gradations of the sliding rule are arbitrarily made to correspond in size to years the result as read is already in terms of years and no further computation is needed.<sup>1</sup>

<sup>1</sup> (Full article on the subject to be published in the China Medical Journal)  
O. B.



## SPECIAL COMMUNICATIONS

### STATURES AND WEIGHTS OF CHILDREN UNDER SIX YEARS OF AGE

By Robert Morse Woodbury, Ph.D. U. S. Department of Labor,  
Children's Bureau. Washington, 1921.

In this publication Dr. Woodbury gives welcome material on the growth of 172,000 American children, selected according to the reliability of data from among 2,000,000 cards received as a result of the Children's Year Campaign. The returns contain observations on stature and weight of children from birth up to six years. The discussion of these statistical tables refers to averages and variabilities of the whole series; to a comparison of physical development in a few selected parts of the country; to the development of a few selected nationalities; and to the effect of defects, particularly rachitis, malnutrition, heart abnormalities, carious teeth, enlarged and diseased tonsils and adenoids.

The material is very valuable because our knowledge of growth during the first few years of life is very inadequate. The composition of the series and the exclusion of certain groups of individuals for various reasons have been carefully considered.

On the other hand the statistical treatment is not sufficient to bring out the essential points involved. There are certain characteristics of the whole series which are not considered and that may have an important effect upon the final values as given in Dr. Woodbury's tables. The number of individuals are grouped in intervals of single months including the period from birth to one month of age, from one to two months of age, etc., so that on the whole they may be considered as of average age of one-half month: i.e. .5; 1.5; 2.5. . . up to 71.5. The number of individuals included shows that very young children from birth up to three months of age were reluctantly presented for examination, the more so the younger they were. The period from 3.5—12.5 months shows the highest levels of children examined. At about 12 months the number drops to a lower level and there are other drops at the age of 48 months and at the age of 60 months. These numerical changes occur equally in boys and girls (see tables pp. 18-20). In



three sections, Iowa, California, New York City, the same drop occurs at 12 months and at 60 months. In California and New York City it also occurs at 48 months. It would be desirable to have the causes of this selection stated. So far as the data show, it does not bring about a particular change in the rate of growth.

Unfortunately the measurements of stature were published in full inches, although some were recorded in lesser intervals. Since the whole range of variability of stature is slight, the large interval that has been used affects all the variabilities which are about 0.03 too high. Since in the calculations, no allowance has been made for the effect of the wide range of interval, the mean square deviation for an interval ought to have been taken as equal to the observed mean square deviation minus  $1/12$ .

Another error in the calculations of variabilities is introduced by the neglect to consider the annual growth. This effect is considerable, particularly when growth is rapid. The variability at a given moment may be called  $\sigma$ . When we call the annual rate of growth  $d$ , we have a total variability of  $\sigma^2 + \frac{1}{12}d^2$ .

Still another difficulty is due to the fact that during the earliest months and again when there are sudden changes in the numbers involved, the average does not express the average for the middle of the month. Thus, for instance, for the first interval from birth until one month, the probable average is about .67 months instead of .50 months and this would modify the average for the year and also the variability very considerably. For these reasons, the numerical values given in Dr. Woodbury's tables all require corrections, at least for the first few months.

## BOYS

	STATURE		VARIABILITY		WEIGHT		VARIABILITY	
	Woodbury	Corrected	Woodbury	Corrected	Woodbury	Corrected	Woodbury	Corrected
0.5	21.16	20.93	$\pm 1.43$		9.11	8.87	$\pm 1.77$	
1.5	22.47	22.46	$\pm 1.29$	$\pm 1.20$	10.88	10.86	$\pm 1.89$	$\pm 1.79$
2.5	23.58	23.58	$\pm 1.25$	$\pm 1.18$	12.61	12.61	$\pm 2.04$	$\pm 1.96$
3.5	24.53	24.53	$\pm 1.30$	$\pm 1.26$	14.12	14.12	$\pm 2.19$	$\pm 2.13$

The curves on rate of growth which are given on page 24 contain decided yearly periodical variations, with minima at about 12, 24, 36, 48 and 60 months. This periodicity may be based on the periodic changes observed by Makeprang in Denmark, by Porter in Boston and by Gebhart in New York City. If we assume, for instance, that the observations were all made at the beginning of the period of rapid

growth, then a child six months old would have lived essentially during a period of slow growth and would, therefore, be comparatively speaking small. A child one and one-half years old would have passed through two periods of slow growth and one of rapid growth. On the other hand a child one year old measured at the same time would have passed through one period of slow and one period of rapid growth and a child two years old would have passed through two periods of rapid and two of slow growth. This would result in all children on the half year being, comparatively speaking, small, and those on the full year being, comparatively speaking, tall and consequently the differences would also show an annual periodicity.

The tables show a very decided and characteristic increase in variability. They show also a very considerable amount of asymmetry, as may be observed in Table 3 and those following. Important inferences might have been drawn from this distribution of variabilities. During the first few years, the rate of growth is decreasing rapidly. We know that part of the variability in stature and in weight is due to retardation and acceleration. If the amount of retardation and acceleration were distributed symmetrically around the chronological age of the child, then, with a decreasing rate of growth, the lower branch of the distribution curve would be extended, the upper branch compressed. This is the reverse of what is shown here and the question therefore should be asked how this comes about. Either the rate of growth is quite different for individuals of different hereditary character, and this difference is such that tall children grow in stature and weight very rapidly; or children who are retarded are liable to continue to be retarded and others who are accelerated will continue to be accelerated and the relation of retardation and excess in stature is not a linear relation.

In other words, we must assume that children who are accelerated are likely to be still more accelerated in the following period, while children who are retarded will continue to be retarded, but not as much as they were retarded before. Obviously the true relations which are involved here can be determined only by repeated observations of the same individuals. That the development of the variabilities is in part due to acceleration and retardation can be proved by the fact that the correlation between stature and weight is the greater, the more rapid the rate of growth. I have determined these data for the period from 2-6 months from the table given on page 32 and I find the correlation between stature and weight for  $2\frac{1}{2}$  months 0.57; for  $3\frac{1}{2}$  months

.45; for  $4\frac{1}{2}$  months .38; for  $5\frac{1}{2}$  months .36. The rapidity of growth decreases during this whole period. An accelerated child will be accelerated both in stature and weight and the two measurements will therefore be closely correlated. At a later time when the rate of growth in both stature and weight is less, an acceleration of development will not have an equally strong effect upon the coefficient of correlation. An investigation of the growth of boys at a later period which was carried on by Dr. Clark Wissler and myself, has proved this particular kind of correlation.

Dr. Woodbury is evidently not responsible for the plan of collecting the data, but his task was the discussion of the results. Obviously some of the important points might have been cleared up by a more detailed examination of the material, but it ought to be understood that the time has come when the collection of vast numbers of observations taken a single time will help very little in the further study of the phenomena of growth. What we need now is a careful study of growth curves of individual children and most carefully collected statistical data in regard to descent and the environmental conditions under which the child grows up.

FRANZ BOAS.

#### ANATOMICAL AND ANTHROPOLOGICAL ASSOCIATION OF CHINA

At the annual meeting of the Anatomical and Anthropological Association, held Wednesday, June 7th, 1922, Dr. Davidson Black gave an illustrated talk on "The progress of the Third Asiatic Expedition of the American Museum of Natural History during the early part of this season's work."

At the close of the discussion a business meeting was held at which the President, Secretary-Treasurer and Councillors were unanimously reelected to office. The Secretary-Treasurer, Dr. Charles Packard, presented his report and the President, Dr. Davidson Black, briefly outlined a general plan of work for the coming year whereby it is hoped the scope and interests of the Association may be enlarged. It is proposed to hold the meetings of the Association for the presentation and discussion of topics of a more strictly technical nature, as far as possible in conjunction with the following societies: The Faculty Medical Society and the Journal Club of Laboratory and Clinical Medicine of the Peking Union Medical College, and the Peking Branch of the China Medical Missionary Association. In addition it is further pro-



posed to hold a number of open meetings of the Association during the year for the presentation of papers of more general public interest both by members and by visiting scientific men.

The following is a brief abstract of Dr. Black's address:

Through the courtesy of Mr. Roy C. Andrews, leader of the Expedition, it has been my good fortune to be the guest of the Third Asiatic Expedition of the American Museum of Natural History during the first few weeks of this season's work. I was able to accompany the Expedition as far as Urga and with Mr. Andrew's generous help to secure a considerable amount of valuable material for the Department of Anatomy of this institution.

The Expedition left Kalgan on April 21st and from the outset has been singularly successful, especially in the realm of geology and palaeontology. An extensive Cretaceous deposit has been discovered, and for the first time in Eastern Asia fossil remains of Dinosaurs have been found; of these both the duck-billed herbivorous type and carnivorous forms have been identified by Dr. Granger. Eocene, Oligocene and Miocene deposits of Tertiary time have also been located and numerous fossil mammalian remains have been recovered, among which are fragments of an enormous animal closely related to if not identical with Foster Cooper's *Baluchitherium*, the largest land mammal yet known. Professor Berkey and Dr. Morris have been able to make further observations on the geology of the area thus far traversed which will be of great importance in throwing light upon the obscure questions of the continental structure of Eastern Asia. Mrs. Andrews who accompanied the Expedition to Urga in charge of the work of color photography has been successful in obtaining a large number of unique studies. Mr. Shackelford who is the motion picture historian of the Expedition has had unusual opportunities to record events of interest, and for the first time permission has been granted to photograph the great spring festival of the Mytr in Urga in all its magnificent detail. The difficulties of transport under all conditions of weather have not been few, but so far the cars under supervision of Mr. Colgate have stood up well under the severe strain of heavy loads and hard travel. The Expedition will continue its work during the summer months.

#### ANTHROPOLOGICAL SOCIETY OF ST. LOUIS

The following papers have been presented before recent meetings of the Anthropological Society of St. Louis: W. K. Moorehead, Exploring the Cahokia Group of Mounds; Albert Kuntz, Hand-arm ap-

pendages as a Factor in the Evolution of the Brain; B. E. Lischer, Dento-facial Deformities; M. T. Burrows, The Nature of Forces acting in the Development of Morphological Form; Clark Wissler, Time Perspective in Culture and Race; F. H. Ewerhardt, Normal and Faulty Posture; LeRoy F. Heimburger, Chinese Social Customs.

In addition to the formal paper, the custom has been inaugurated of setting aside a few minutes at each meeting for exhibition of specimens and discussion.

During the past year the society has taken the lead in the organization of a committee and collecting of funds to start an archaeological survey of Missouri. Dr. R. J. Terry formerly president of the society has been made Permanent Chairman of the new committee.

C. H. DANFORTH,  
*Secretary*

#### AN APPEAL FOR AN IMPERIAL SCHOOL OF APPLIED ANTHROPOLOGY

(By Temple, Sir R. C.—*Man*, Oct. 1921, 150-5, Nov., 173-5.)

On September 8, 1921, in Section *H* of the B. A. A. S., Sir Richard Temple presented a strong plea for the organization of a central English Anthropological Institute under Government auspices, giving valuable historical data relating to the development of the proposition.

After a good discussion of the matter, the following resolution was passed by the Section:

"That it is in the interests of the Empire that a knowledge of anthropology should be more widely disseminated; that for this purpose Universities and other institutions be encouraged to provide instruction in this subject; and further that there should be a Central Institute in London for the collection, co-ordination and publication of the results of anthropological research and the provision of information derived therefrom for the use of the Imperial services, traders, missionaries and others; that the Council of the Association, in conjunction with other bodies interested, take such steps as may be necessary to secure this end."

#### GLACIAL CHRONOLOGY

Dr. Fleure and Mr. Harold Peake have recently constructed a chronological chart of the period which has elapsed since the last (Würm) glaciation, based largely upon the investigations of Baron de Geer. In this they have sought to equate the various glacial advances noted by Penck with the Scandinavian moraines and the changes in the

coast-line of northern Europe, as well as with the various periods and sub-periods of the upper paleolithic and later ages as defined by the French and Scandinavian archaeologists. As some of our readers may like to have copies, they propose to have some reproduced by Fidelo-graph process; these may be obtained at the price of 2 shillings each, post free, on application to Mr. Peake, Westbrook House, Newbury, Berks, England.

*Man*, 1921, XXI, No. 11.





## LITERATURE

### EVOLUTION, EARLY MAN

INITIATIVE IN EVOLUTION. By Kidd (Walter)—8°, London, 1920, 262 pp.

A serious work based largely on evidence from arrangement of hair in different species, arrangement of papillary ridges, flexures of the palm and the sole, evolution of the bursae, characteristics of the plantar arch, peculiarities of muscles, innervation of the human skin and the reflex arcs. The conclusions of the author are thus summarized:

"That Plasto-diethēsis, or the moulding and sifting processes experienced by organisms, represents the beginning and end of higher animal evolution; and that its wide hyphen stands for the provinces where Mendelism, Mutationism, Tetraplasty, Orthogenesis, and the dynamical work of growth on Form, as well as other factors yet to be discovered, can range at large.

That personal selection is the leading form of that process in higher animals, whereas among Invertebrates, especially unicellular forms, selection of groups is the rule.

That Initiative in animal evolution comes by stimulation, excitation and response in new conditions, and is followed by repetition of these phenomena until they result in structural modifications, transmitted and directed by selection and the laws of genetics—a series of events which agree with Neo-Lamarckian principles.

That undesigned experiments in the arrangement of the Mammalian hair and the production of new bursae, as well as the designed experiments of Pawlow, support the foregoing claims, with which agree the converging facts of: varieties of epidermis, arrangement of the papillary ridges, flexures of the palm and sole, the formation of the plantar arch, the origin of certain muscles, the innervation of the human skin, and the building of reflex-arcs.

That there is a large place in higher animals for the Evolution of the Indifferent through the action of use and habit.

That the position for Initiative in Evolution here advanced is no bar to unlimited research."

SIDE LIGHTS ON THE EVOLUTION OF MAN. By Pearson (Karl)—*Eug. Lecture Series*, No. XIII, Lond. Univ., Lond., 1921, 8°, 27 pp. 7 pl.

A detailed study of the thigh bone of the Primates has convinced the author that the ancestry of man must be traced through troglodyte rather than hylobatic lines. The result of 40 indices secured on the femur show that:

"(i) As in our separate diagrams the thigh-bone of *Tarsius* is remote from all resemblance to that of man.

(ii) The Recent Gibbon and Recent Gorilla are most remote from the simio-human mean and show therefore most specialization.

(iii) It is the chimpanzee in the first place, and the orang in the second which are closest to man.

(iv) The femur of man is the least removed from the simio-human mean, and it may for this reason probably be more primitive in many of its features than those of anthropoids."

The gibbon "cannot be interpolated in any form as a direct ancestor of man, between the branch point of the baboons and that of Neanderthal Man" (p. 15).

THE MANHOOD OF HUMANITY. By Korzybski (Alfred)—8°, N. Y. (E. P. Dutton & Co.), 1921, 264 pp.

Original, refreshing philosophy. In nine chapters the author deals with the "Method and Processes of Approach to a New Concept of Life"; "Childhood of Humanity"; "Classes of Life"; "What is man?"; "Wealth"; "Capitalistic Era"; "Survival of the Fittest"; "Elements of Power"; "Manhood of Humanity". His aim is "to point the way to a new science and art—the science and art of Human Engineering". By "human engineering" he means "the science and art of directing the energies and capacities of human beings to the advancement of human weal." Man is distinguished from all others by being a "time-binder"; he "makes the past life in the present and the present in the future". This time-binding energy "what may it not achieve in course of the aeons to come?" To which are added certain recommendations.

Sound ideals apparently—but ideals.

SU L'ORIGINE DELL'UOMO, NUOVE TEORIE E DOCUMENTI. By Giuffrida-Ruggeri (V.)—8°, Bologna, 1921, 267 pp.

A critical résumé of the newer theories and publications relating to man's origin. The eleven chapters deal respectively with: General Theories relating to Man's Evolution; Special Theories on the Origin of the Human Philum; Origin of New Species with Special Reference to the Primates; The Most Ancient Fossil Remains of Man; Other Human Fossils; The First Migrations—the Equatorial Races; The Fossil Skull of Talgai and its Significance for the Origin of the Australians, Tasmanians and Melanesians; The Boreal Races; Domesticity of Man; Eugenesia of Man as a Consequence of Domesticity and the Great Original Affinity; Conclusions.

Evidently the object of the author was not so much to advance a system of his own opinions as to criticize the biassed theories of authors who endeavor to introduce confusion into the progress of anthropology. He shows however repeatedly in the course of the discussions his inclinations, which on the whole, follow the best of modern workers.

ZUR FRAGE DER DOMESTIKATIONSMERKMALE DES MENSCHEN. By Fischer (Eugen)—*Z. f. Sexualwiss.*, 1921, VIII, H. 1, 3 pp.

Author calls attention to the growing need of studies of biological nature on the vast array of variations in man that arose under his



domestication, and points out various modifications of this nature in the sexual organs and functions. A small paper well worth perusal.

PRÉSENTATION D'UN CRÂNE D'ENFANT AGÉ DE 8 ANS, TROUVÉ EN PLACE DANS LE MOUSTÉRIEN SUPÉRIEUR DU GISEMENT DE LA QUINA (CHARENTE). By Martin (Henri)—*Bull. & Mém. Soc. Anthropol.* Paris, 1920, n.s.I, Nos. 4-6, 113-125.

Dr. Martin gives here a detailed account and study, with a very good illustration, of the ancient child skull discovered in 1915 at La Quina. It is the first well-preserved child's skull from the Neanderthal period, and it shows already, more or less accentuated, the main characteristics of that type. The teeth, particularly the upper milk dentition pre-molars, show primitive conditions. The cephalic index of the skull amounts to 77.

STUDIEN ÜBER DAS FEMUR VON PITHECANTHROPUS ERECTUS DUBOIS. By Schwalbe (Von G.)—*Z. f. Morph. & Anthropol.*, 1921, XXI, H. 3, 289-360.

A posthumous, uncompleted, nevertheless a valuable publication on the much-discussed Trinil femur, published without alteration by Eugen Fischer, and giving many detailed observations, measurements and comparisons.

The conclusions unfortunately are but partly formulated, nevertheless there are some statements of importance. It appeared to Professor Schwalbe far more probable that the femur belonged to the rest of the Trinil finds (the skull and teeth) than that it represented a being apart. That the bone appears so near human while the skull is apparently of a much lower order constitutes no real incompatibility; it is very probable that the biped habit of the Pithecanthropus influenced the femur much more promptly than the rest of the evolutionary changes have affected the skull. The presence of the exostosis on the Trinil femur has no bearing on the derivation of the bone. It is evident that in the opinion of Professor Schwalbe the Trinil remains represent an intermediary form between the apes and man, but he does not express himself on the question of whether or not he regarded this form as ancestral to man.

THE PREHISTORIC FIND AT PILTDOWN. By Waterston (—)—*Proc. R. Phys. Soc. Edinb.*, 1921, XX, Part 5, 211-216.

A brief review of the evidence relating to the Piltdown skeletal remains. The author reached the conclusion that "at Piltdown a discovery of the first importance has been made. It has established the presence in England in the Pliocene or Pleistocene period of a form of anthropoid hitherto almost unknown in Europe, and also of a form of elephant hitherto unknown in Western Europe.

It has established the existence in England in the later Pleistocene time of a human species resembling closely in many details the Aurignacian race. It has added another to the evidences already known of the existence of man in a form similar to his present form at a very remote geological period.

On the question of the relation of the cranium and mandible I am convinced that in dealing with separate fragments of uncertain origin, and of a mixed kind, each bearing indubitable evidence of its general affinities, it is not permissible to combine together such fragments in a single skeleton without clear evidence that such a combination really existed. Especially is this the case in regard to two elements such as the mandible and the cranium, when, as in the present case, such association infringes the whole of the harmony of correlation which has hitherto been found to exist in authentic, complete specimens of similar prehistoric remains. The teeth, moreover, have now been shown not to possess the human characters at first attributed to them, and with this the only ground for assigning the mandible to the cranium has disappeared."

THE FOSSIL MAN OF RHODESIA. By Smith (G. Elliot)—*The Atlantic Monthly*, April, 1922, 454-465.

One more preliminary report on and discussion of the remains of man from the Broken Hill cave in Northern Rhodesia written in the finished and attractive style of one of the foremost English anatomists. It brings a number of new interesting details; and while its conclusions are largely of a tentative nature, they deserve the full attention of science.

"If it were not for the fact that originally there had been a cleft in the roof of the cave just above the place where the skull was found, we might have drawn the conclusion that the men or women whose bones were found in the depths of the cave had already met their death before the hyenas made it a dining hall and began the accumulation of the vast collection of animal bones, which represents the work of, perhaps, many centuries. But the cleft does leave open the possibility of the human beings having fallen into the cave at a more recent period. However, the fact that all the bones which have been examined represent animals of species that are still alive in Africa shuts out any possibility of determining the age of the human remains. In addition to this, the incrustation of the surface of the human bones with salts of zinc and lead has protected them from the action of the soil, so that, in the strict sense of the term, they are not fossilized. Although the bones are not mineralized, or, strictly, fossilized, the custom of human palaeontologists makes it not incorrect to refer to these bones as "fossils." If the investigator is grateful for this protection of the texture of the bony remains, he has to lament the absence of even the slightest indication of their age, which the state of fossilization might have afforded, had the circumstances been other than they were." (?)

". . . the circumstances under which the Rhodesian remains were found afford no indication, not the merest hint, of their age or the place of their possessor in the human family. Any inference that attempts to settle these problems must, therefore, be based upon the features of the bones themselves.

The obtrusive fact which no one can fail to notice, is the appearance of the face, revealing as it does a form that has never been seen before. It is certainly the most primitive type of face that is known among

members of the human family. . . .I do not mean to suggest that the Rhodesian skull is the most primitive type of human being so far recovered. . . .

The form of the brain-case and the peculiarly distinctive features of brain that it once contained, corroborate the inferences drawn from the face, that the Rhodesian species was the most primitive member of the genus *Homo* at present known, but not the most primitive of the human family, which of course includes the vastly more ancient and lowlier genera *Pithecanthropus* and *Eoanthropus*. The long straight shin bone and the fragments of the femur afford a very clear demonstration of the fact that Rhodesian man is separated by a very considerable hiatus from his nearest relative, the extinct European Neanderthal man."

The remains of the *Pithecanthropus* and *Eoanthropus* represent "far and away the most primitive members of the human family known to us at present." "The possession of the lower jaw of *Eoanthropus* makes it possible for us to restore with confidence the general form of the face." (p.4 56.)

The Neanderthal phase of man still represents for Dr. Elliot Smith, as for many others, a distinct species of man (p. 460-1). "The outstanding feature of the Rhodesian man's traits is the suggestion of a half-developed Neanderthal man, with some of his peculiarities grossly exaggerated, while others are lacking, or replaced by primitive features that more nearly approach the type of modern man."

"The brain-case of the Rhodesian skull does retain a number of characters definitely more primitive than those of either *Homo sapiens* or *Homo neanderthalensis*." The brain of the Rhodesian man was larger than that of *Eoanthropus* but smaller than that of the Neanderthal man; and it shows a poor development of areas associated with the higher intellectual functions. It "was deficient in those parts by which the high degree of foresight, discrimination and refinement of modern man is determined and made possible."

As to the rest of the bones "the (assumed) erectness of Rhodesian man cannot be fatal to the claim to regard him as primitive. In the meantime, the evidence provided by his face, brain-case and endocranial cast, seems to me to point conclusively to the fact that, in the bones found in the Broken Hill mine, we have the remains of a type of mankind definitely more primitive than all the known members of the human family, with the exception only of *Pithecanthropus* and *Eoanthropus*, from Java and Piltdown respectively."

The complete evidence relating to the Rhodesian find is promised to be printed within this year.

#### RACES, PEOPLES

A GROUP OF ROMAN IMPERIAL PORTRAITS AT CORINTH. By Swift (E. H.).—*Am. J. Archaeol.*, 1921, XXV, 248-265.

Recent excavations by the American School of Archaeology at Corinth resulted in the recovery of several busts of Roman emperors. The pres-



ent article describes a particularly fine portrait head of Tiberius. It belongs to the well-known broad-headed type.

ANCIENNE ET ACTUELLE POPULATIONS DE LA SUISSE. By Zaborowski (S.)—*Rev. Anthropol.*, 1921, XXXI, Nos. 5-6, 141-154.

Though man lived in Switzerland before the end of the Quaternary, he apparently disappeared during the height of the last ice invasion and did not return to people the territory until long thereafter, perhaps not until the middle of the Neolithic period. He then came from the west, from the Rhone Valley; he was a hunter and represented in the main the oblong-headed neolithic type of the population of that time in western Europe. The next comers were the pile-dwelling people, among whom was admixed a strain of small-statured brachycephals. Twenty-seven neolithic crania from various parts of Switzerland show 7 percent brachycephals, 59 percent mesocephals and 33 p. c. dolichocephals. There were short people but no race of pigmies. With the appearance of copper after 2000 B. C. comes a wave of tall oblong-headed people from the east or northeast, the Gauls. The pile-dwelling skulls from the Iron Age show a mixed population giving cephalic indices varying from 68 to 88. The so-called "Alpine" type, brachycephalic, from further eastward, extended over a large part of the territory during the Bronze Age, bringing with it the habit of cremation of the dead. La Tène people of the Iron Age, well built and of oblong head, extending from Bohemia along the Danube and Rhine, were the old Gauls or Celts. During this age however, the type becomes more and more modified by admixture with the short-headed immigrants of the Bronze Age, the resulting people being ultimately recognized as the "Helvetians." These in 58 B. C. are half annihilated by the Romans. Rome dominates Switzerland for four centuries. In and after 264 however, the northern parts of the country are settled by the Alamans, a Germanic tribe; in 433 western Switzerland is invaded by the Burgundians; in 496 the Franks overcome the Alamans and in 536 also the Burgundians, but produce little effect on the population. The Swiss of the parts occupied by the Alamans speak to-day a dialect of the Germans; those occupied by the Burgundians who were not pure Germans, having come originally from the Slav territories between the Odra and Visla, speak French. The Italian-speaking population of southern Switzerland represents a recent infiltration from northern Italy, while the "Ladins" seem to represent in the main latinised Slavs.

The present Swiss average 163. in stature; the Germanic long faced dolichocephals have been merged into the population; brachicephaly with rounded face, in most of the cantons, is common. There are but 11 percent of blonds, 25 (and above) percent of brunets.

LES PEUPLES NON-ALLEMANDS DE LA PRUSSE. By Vaux-Phalipau (Mme de)—*Rev. Anthropol.*, 1921, XXXI, Nos. 7-8, 230-237.

The old Prussians or "Borusi" were one of the three branches of the Lithuanians. Their descendants form still a strong part of the popula-

tion of Eastern Prussia. The article gives the main historical details with notes on their present state and attitude.

RECHERCHES ANTHROPOLOGIQUES DE LA POLOGNE. By Czekanowski (Jan)—*Bull. et Mém. Soc. d'Anthrop. Paris*, 1920, I, Sér. 7, Nos 1-3, 48-70.

In his intensive study of anthropological conditions in Poland, the author arrives at the conclusions that the territories of present Poland show evidence of various populations, partly of local development, but largely the effects of ethnic movements from various directions during the last 1500 years or more. He believes himself able to distinguish seven anthropological "provinces" with six anthropological types of population; and finds it difficult to refer all these types to the three classic races of Europe (the Nordics, Alpines and Mediterraneans). A good Polish bibliography is appended.

Studies of this nature are confronted with the great difficulty of not being able to study the respective groups of population in the course of their existence, in consequence of which they are unable to differentiate between the elements of immigration, admixture and the local physical changes in a population, the latter of which are possibly much more effective than generally believed.

Anthropological investigations in the territories now controlled by Poland are of a very great future importance for they not only embrace the cradle of all the Slavs, but the country was also the avenue for ancient eastward extension and proto-as well as early historic invasions from the north southward, not to count the results of the Hun and Mongol pushes westward.

LES SERBES D'ALLEMAGNE. By Haumant (Emile)—*Rev. Anthropol.*, 1921, XXXI, Nos. 5-6, 155-166.

Article of general and historic nature calling attention to the Lusatian Slavs (Wends or Sorbs) of Saxony and Brandenburg.

EARLY JUGOSLAV LITERATURE. By Stanoyevich (Milivoy S.)—8°, Columbia University, N. Y., 1922, 91 pp.

A most welcome book, giving the early as well as the later history of the southern Slavs, which is almost unknown in this country. It would be highly desirable however if, in some future edition or another contribution, the author could give us separately the literature on such subjective matters as the origin, migrations, history, linguistics, and if possible also the archaeology and anthropology of the regions occupied by the Yugoslav people.

I DATI CRANIOLOGICI SULL'ALBANIA E DUE CRANI ALBANESI INEDITI (CON UNA FIGURA). By Giuffrida-Ruggeri (V.)—8°, no pl., 1921, 15 pp.

Measurements and description of two Albanian skulls with data on 22 male and 10 female Albanian crania published by other authors. With two exceptions, one of which seems clearly an intrusion, the skulls are all subbrachy to brachycephalic and medium-high to high. Average indices: *Cephalic* 86.3; *L. H.* 78.5; *Facial, sup.* 52.1; *Orb.* 84.4; *Nas.* 49.6.

QUELQUES OBSERVATIONS SUR LES GALTCHAS. By Hansen (Soren)—*Rev. Anthropol.*, 1921, XXXI, Nos. 7-8, 238-242.

Results of new studies on the Galtchas of Pamir, based on measurements of 100 individuals by Lieut. Olufsen (head of a recent Danish expedition to that country) and of one skull studied by the author (details published in "Through the Unknown Pamirs," London, 1904).

The type of the Galtcha cranium has long been regarded as very close, if not identical with that of the skulls of the Alpines. The author, after showing that the measurements he deals with show a strong brachycephaly with other interesting features, discusses the probable relation of the Galtchas with the Tadjiks of the plains; and inclines to the opinion that "the Alpine type has developed under the influence of Alpine environment."

LES HÉTÉENS, LES MIGRATIONS DE L'ÂGE DE BRONZE EN EUROPE, LE RITE DE L'INCINÉRATION DES CADAVRES. By Zaborowski (S.)—*Bull. & Mém. Soc. d'Anthrop.* Paris, 1920, Sér. 7, Nos. 4-6, 146-158.

The brachycephals of Crete, coming from Cyprus, were of Asiatic origin and identical with the Hittites. The Hyxos who overcame Egypt were also in the main Hittites. They were settled to the north of Syria, including Paphlagonia. The type is not Mongoloid. Descendants of the Hittites may still be seen in the country people north of Boghas-Kioi, their old city. They were the autochthones of Asia Minor, of the same language and race apparently with the Medes. The Etruscans were partly Hittite, partly of Assyrian composition. During the bronze age the author assumes a great immigration of these Asiatic brachycephals to central Europe. They were the ancestors of the pile-dwelling people of Switzerland, the ancestors of the Alpines. They brought with them the custom of cremation. The Vénètes were Medes, or people of the same stock; they (with the Ligures) were the proto-Slavs. They may have come over Thrace about the time of the Trojan wars. The practice of cremation was Medean.

If only anthropology could reach accord on all these questions!

LES SACES OU ARYENS BLONDS DE L'ASIE CENTRALE. By Zaborowski, (S.)—*Bull. & Mém. Soc. Anthropol.* Paris, 1920, n. s. I, 126-133.

In connection with his remarks about the work of Gustav Retzius, with interesting references to the peopling of Scandinavia (p. 128) and to cranial deformation (p. 132) the author gives some valuable points on the Saces and related peoples of central western Asia. He justly regards these as of European (Neolithic) origin and expresses himself against the assumption that the condition may have been *vice versa*.

NOTES ON THE STONE AGE PEOPLE OF JAPAN. By Matsumoto (H.)—*Am. Anthropologist*, 1921, XXIII, No. 1, 50-76.

A considerable archeological activity in Japan during the last ten years has resulted in the recovery of a goodly number of neolithic skeletons, the characteristics of which are the subject of this paper. Unfortunately the paper was written in America and from memory only.



The Neolithic crania and skeletal parts of Japan show numerous similarities as well as certain differences, and the latter permit the author to classify them into three types namely:

A. *Aoshima Type*. Skeletons from the site of Aoshima and a part of the skeletons from the site of Miyato island. Moderately short, male adults standing about five feet two to four inches. Large headed. Dolicho-mesocephalic.

B. *The Miyato Dwarf Type*. Part of the skeletons from the site of Miyato island; also a part of those from the sites of Tsukimo and Kô. Very short, male adults standing about five feet to five feet two inches. Size of head, moderate; meso-brachycephalic and also to brachycephalic.

C. *The Tsukomo Tall Type*. Part of the skeletons from the site of Tsukomo and also of Kô. Tall, male adults standing about five feet six or seven inches. Large-headed, but may be moderate if taken in proportion to the height of body. Meso-brachycephalic.

Four types are recognized by native students among the Japanese of the present day, with two others among the Aino.

As to the latter "One type, including about two-thirds of the total number of the modern Ainu of Hokkaido, comparatively tall (about five feet three to four inches or near that) and comparatively long-headed (cephalic index ca.  $75-76\pm$ ), while the other type comprising about one-third the total number, is very short (about five feet to five feet one inch) and comparatively broadheaded (cephalic index ca.  $79-80\pm$ ). . . .

"The first type of the modern Ainu appears to correspond well to the Aoshima type of the stone age, and the second type of the same to the Miyato dwarf type of the stone age."

As to the Japanese, Hasebe recognizes the "Ishikawa" and "Okayama" types, to which Matsumura adds the "Chikuzen" and "Satsuma." The Ishikawa type "is characterized by the very short stature (five feet to five feet one inch), not very broad head (cephalic index ca.  $78\pm$ ), straight and shallow face and weak jaws; the Okayama type by the tall stature (five feet five inches or more), broad head (cephalic index ca.  $82$  or more) convex and deep face and strong jaws; the Chikuzen type by the tall stature (five feet five inches or more) and not very broad head (cephalic index, ca.  $78\pm$ ); and the Satsuma type by the very short stature (five feet one inch or near that) and broad head (cephalic index ca.  $82\pm$ ).

"The Ishikawa type is to be met with abundantly in the northern middle part and northeastern part of the main island; the Okayama type in the coastal districts around the inland sea, in Kinai, i. e. the former capital Kyôto and its vicinity, and in the western middle part of the main island; the Chikuzen type in the northern part of Kiushû; and the Satsuma type in the southern parts of both Kiushû and Shikoku.

"The Ishikawa type appears nearly, though not yet thoroughly, to correspond to the Miyato dwarf type of the stone age, and the Chikuzen type also nearly to the Tsukomo tall type of the stone age. The Ishikawa and Chikuzen types may possibly be Mongolianized survivors of

the Miyato dwarf and Tsukumo tall types respectively. . . .The Okayama type which has been looked upon by Professor Hasebe himself to be the Korean type of the Mongolian stock, is not yet actually discovered from the stone age sites of Japan."

THE NATIVE TRIBES OF YUNNAN. By Ting (V. K.)—*China Med J.*, March, 1921; repr. 5pp.

Except the Miaotse all the people measured belong to the Lolo family who have often been noted by travellers as showing many non-Mongoloid characters such as tall stature, fair skin and more regular features. The cephalic indices of the three series given show clearly that on the whole both the Lisos and the Lolo are dolichocephalic. This may also be an indication that the Northern Lolos had some blood other than Mongolian. Historically the Lolos were in association with the Ch'iangs who formed an important people in North-western Szechuan, Kokonor, and Southern Turkestan. In the last place they were known to have intermarried with the Iranian people known as Yuehchi. The Iranian element may have found its way into the Lolos through the Ch'iangs. That would account for the non-Mongoloid cephalic indices as the Iranians were certainly dolichocephalic.

SUR LE MOUVEMENT DE LA POPULATION MÉTISSE AU TONKIN. By Bonifacy—*Bull. et Mém. Soc. d'Anthrop.* Paris, 1920, Sér. 7, Nos. 4-6, 136-139.

Author gives 10 years statistics on births and marriages of whites and mixed-bloods in Tonkin. The mixed-bloods are steadily increasing in numbers, the whites decreasing.

ANCIENT CAVE DWELLERS OF BATWAAN, MASBATE, PHILIPPINE ISLANDS. By Smith (Warren D.)—*Philip. J. Sc.*, 1921, XIX, No. 2, 233-240, 5 pl.

Author has explored four caves, of which one had been used for living and one for burials, in the island of Masbate. In the latter was found a pile of human bones, with 44 skulls. Most of the latter showed artificial deformation of the Aymara type. Some of these skulls seem to indicate the presence of the Negrito. Neither cave dwelling nor head deformation is now or has within the memory of the natives, been practised on the island. A detailed study of the skulls will probably be made later.

STATIONS ET SÉPULTURES NÉOLITHIQUES DU TERRITOIRE MILITAIRE DU TECHAD. By Gaden (H.) & R. Verneau.—*L'Anthrop.*, 1921, XXX, Nos. 5-6, 513-543.

Professor Verneau describes here three imperfect skulls apparently of neolithic age from Yao in the territory of Tchad. The skulls show negroid characteristics in the main but also some peculiarities which make the collection and study of further material for this nature very desirable.

There is a strong urge that studies relating to early man in Africa be henceforth carried on more assiduously than in the past, for there are

some very important problems in anthropology of that continent—the origin of the negro, negrito and perhaps man himself—which demand solution.

A PROPOS DE LA CORRESPONDANCE SUR LES PYGMÉES. By Zaborowski (S.).—*Bull. & Mém. Soc. d'Anthrop.* Paris, 1920, I, Sér. 7. Nos. 1-3, 70-71.

The author points to the close physical resemblance of the Gabon pygmies and the Bushmen.

#### DEVELOPMENT GROWTH

THE SKULL OF A HUMAN FETUS OF 43 MILLIMETERS GREATEST LENGTH. By Macklin (Charles C.).—*Contrib. to Embryol.*, No. 48, Pub. 273, Carnegie Inst. of Wash., 1920, 57-103.

The chondrocranium is well developed and is practically a homogeneous mass of cartilage, with but little trace of the regions of earlier separation of the parts. Almost all of it is represented.

The cartilage is almost all of mature type. Young cartilage and pre-cartilage are found principally at the anterior end, which is undergoing the most rapid development.

In all, ten centers were found where the cartilage showed the change which ushers in ossification. Of these, four were paired and two unpaired. In none was actual bone formed. At the peripheries of these centers there was a gradual transition of the modified cartilage into the surrounding normal cartilage. The areas of these centers may be briefly recapitulated:

In the occipital region there are: (1) a single center for the basi-occipital; (2) paired centers for the exoccipitals; (3) a single large center for the supraoccipital.

In the orbito-temporal region there are: (1) paired centers in the temporal wings; (2) paired centers in the alar processes, these being very slightly developed.

The remaining paired centers are found one in each lower end of Meckel's cartilage.

The angle made by the chordal and prechordal parts of the central stem is  $115^\circ$ . It has become narrower since the 21 mm. stage of Lewis, where it was  $125^\circ$ .

That the outer ends of the orbital wings become depressed, thus widening the angle made by the lines joining the limbus sphenoidalis with the lateral extremities of the wings is evident from a comparison of this angle in the specimen under discussion with the corresponding angle in the adult skull. The flattening of the floor of the anterior cranial fossa is probably associated with the growth of the brain.

Parasphenoidal cartilage, or hamular process, is present and intimately associated with the medial, pterygoid plate.

Branchial-arch skeleton. The following cartilages have been described: Meckel's and Reichert's, with ossicle fundaments; hyoid; thyroid; arytenoid; cricoid; upper tracheal.



Cervical vertebrae. They show arch tips widely separated; those of the atlas are the same distance apart as those of the occipital vertebra.

Paraseptal cartilages and ventrolateral processes are rudimentary.

All of the membrane bones, with the exception of the nasal, are represented. Some of them are very small, as the medial pterygoid plate, the parietal, and particularly the interparietal, lacrimal, tympanic and goniale. The palatine surface of the maxilla shows a groove indicating the line of earlier complete separation of the maxillary and premaxillary elements.

WEIGHT, SITTING HEIGHT, HEAD SIZE, FOOT LENGTH, AND MENSTRUAL AGE OF THE HUMAN EMBRYO. By Streeter (George L.)—*Contr. to Embryol.*, Publ. 274, Carnegie Inst. Wash., 1920, 143-170.

Measurements on 704 selected specimens, with the object of obtaining a satisfactory growth curve for the human embryo and determining the normal range of variation in the various dimensions in the different stages of its development. The measurements of each specimen are recorded in tables.

As to Height (Sitting Height), it appears that the weekly increment "is greatest from the thirteenth to the seventeenth week, reaching a maximum of 15 mm. at the sixteenth week. Throughout the remainder of the fetal period the increase is surprisingly constant, varying from 9 to 11 mm. . . ."

"The actual increment in weight, in contrast to the increment in height is a constantly increasing one. The rate of increase is uniform, except for an acceleration between the twenty-eighth and the thirty-second weeks, when it makes maximum jumps of 20 grams, and another acceleration from the thirty-eighth to the fortieth week. The percentage increment in weight is a little over twice that of the percentage increment in height and, like the latter, steadily decreases as the fetus becomes larger. . . ."

"... the normal variation in sitting height for any age over 40mm is from 8 to 10 per cent, and the normal variation in weight for a given sitting height is about 30 per cent. But since the weekly weight increment is about three times greater in its percentage than the sitting-height increment, the difference in accuracy in their use for the determination of age is slight."

As to *foot length*, if this "is plotted as a curve at weekly intervals from the eighth week to term it will be found that the growth is relatively slow at first and does not reach its maximum weekly increment until about the fourteenth week, after which there is a weekly increase of about 3 mm., continuing with slight variation to term."

*Size of the Head.* The head grows steadily until the twelfth week, when there is a slight gradual decline in the rate lasting up to the fortieth week.

For interesting details the reader must be referred to the original.

HEIGHTS AND WEIGHTS OF SCHOOL CHILDREN. By Clark (Taliaferro), Edgar Sydenstricker and Selwyn D. Collins—*Publ. Health Reports*, Wash., May, 1922, XXXVII, No. 20, 1185-1207.

"The basis of this study consists of height and weight measurements of 14,335 native white school children from 6 to 16 years of age, made by officers of the U. S. Public Health Service in representative localities of Maryland, Virginia and North and South Carolina. The mean heights of the girls 11 to 14 years of age inclusive, and the mean weights of the girls 12 to 14 years inclusive, are greater than those of the boys of the same ages. At the other ages studied the boys are taller and heavier than the girls. The weight-height index (weight per inch of height) of the girls exceeds that of the boys from 12 to 14 years and is equal at 15 years; at the other ages studied it is greater for boys than for girls. The annual increment in weight of the girls exceeds that of the boys from 8 to 13 years inclusive. At the other ages studied it is greater for boys. However, when the annual increment in weight per inch of increment in height is considered it is found greater for girls than boys at every age after 6, except 10 years. Variations in height and in weight differ markedly for different sex-age groups and are closely associated with the rate of increase in weight. When variation in weight is considered independently of variation in height, the boys 14 to 16 years of age vary considerably more in weight than the girls of the same age. But when the effect of variation in height is eliminated, the girls vary more in weight than the boys of the same age at all ages above 8 years. In other words, girls after 8 years of age vary more in weight than boys of the same age and height. Correlation between heights and weights was found to be lower for the girls than for the boys at all ages above 8 years and markedly lower after 13 years of age."

PHYSICAL STANDARDS FOR WORKING CHILDREN. *Children's Bur. Publ.* 79, Wash., 1921, 24 pp.

The child who goes to work between 14 and 18 years of age is in need of special protection if he is to arrive at maturity with good health and a vigorous and well-developed body. During these years he is passing through the most critical period of his physical development, when his body must meet the unusual demands of rapid growth and physiological readjustment. If at the same time he is subjected to the mental and physical strain of occupational life, the burden upon his immature physique is a double one, and special precautions are necessary if normal growth and development are not to be endangered. Prohibiting the employment of children in certain occupations generally recognized as injurious to health is an important but obviously limited means of affording protection. Raising the minimum age for entrance upon any employment offers only a partial solution to the problem. A tendency to keep children out of industry until they are at least 16 years of age is becoming apparent in child labor laws, but even with 16 years as a minimum age, large numbers of young persons will continue to go to work before their physical growth is completed and will stand in need of

protection if they are to reach normal development. An effective means of protecting the health of children at work lies in the adoption of standards of physical fitness which all children entering employment are required by law to meet. Such physical standards are proposed.

#### VARIATION: BRAIN; OTHER SOFT PARTS

THE EMBRYONIC CEREBRAL HEMISPHERE IN MAN. By Hines (Marion)—*J. Anat.*, 1921, LV, Part 4, 292.

The medial wall of the cerebral hemisphere of embryos 16 mm. to 30 mm. in length is not perfectly smooth. Its otherwise even contour is broken by a shallow groove which extends from the olfactory bulb to the tip of the temporal pole. This is the fissura hippocampi, the "Bogenfurche" of His. The primordial hippocampus can be identified in embryos about 10 mm. in length by a thicker wall, a narrower matrix, and a more clearly defined marginal velum than the area immediately contiguous to it laterally. This region is separated from the area epithelialis by a sulcus limitans hippocampi.

The fascia dentata arises in the matrix of the ventral limb of the hippocampus as a group of deeply-stained cells which migrate dorsal-ward into its marginal velum. The telencephalon velum is divided into terminal plate and roof by the angulus terminalis. The area epithelialis contiguous to the midplane-region differentiates into three characteristic areas, the septum ependymale, the area intercalata and the lamina epithelialis; that which lies contiguous to the main body of the lamina terminalis forms the septum.

In embryos of 16 mm. in length the ventro-lateral region of the hemisphere is very thick, containing two slight elevations, the medial and lateral roots of the corpus striatum. At this age the medial hillock is larger than the lateral. But in embryos of 20 mm. they are approximately equal in length and depth; and in those of from 27 mm. to 43 mm. the lateral hillock is the greater.

In early stages the cerebral hemisphere expands by intrinsic growth of each particular sector and especially by a marked extension of neopalial tissue. It elongates by acceleration of mid-line growth in the region of the lamina terminalis and the di-telencephalic fold, and by the expansion of areas of new tissue, which form the frontal, parietal and temporal poles. A study of histological differentiation in the early development of the telencephalon in man gives a method of measuring the relative growth of its several parts and thus of contributing to our knowledge of its intrinsic development.

The above are the main conclusions of a valuable paper on the subject published under the title: "Studies in the Growth and Differentiation of the Telencephalon in Man. The Fissura Hippocampi." *J. Comp. Neur.*, 1922, XXXIV, No. 1, 73-171.

ÜBER DIE VARIATIONEN DER HIRNFURCHEN DES SCHIMPANSEN. By Fischer (Eugen)—*Verh. Anat. Ges.*, 1921; in *Anat. Anz.*, LIV, 48-54.

Basing his conclusions on a study of no less than 22 new well preserved brains of the Chimpanzee, the author, without going into some of the



more important morphological details concerning the specimens, discusses the question of the origin of the variations in fissuration and reaches the conclusion that these cannot be all of hereditary nature.

LA VISION ET L'OEIL DE L'HOMME DU POINT DE VUE DE L'ANATOMIE ET DE LA PHYSIOLOGIE COMPARÉES. By Rochon-Duvigneaud—*Bull. & Mém. Soc. d'Anthrop.* Paris, 1920, I, Ser. 7, Nos. 1-3, 1-29.

An extensive and detailed comparative study of the eye in various order of vertebrates, including apes and man. The results show that the human type of the eye is met with also in all the apes, though not in other mammals. "Man sees therefore with the same eyes as the great apes, but he *regards* with quite a different brain."

A STUDY OF FACIAL HAIR IN THE WHITE AND NEGRO RACES. By Trotter (Mildred)—*Wash. Univ. Studies, Scient. Ser.*, 1922, IX, No. 2, 273-289.

No sexual differences and no racial differences in the actual numbers of racial hairs have been found. The facial hairiness of man does not lend itself to the classification proposed by Friedenthal. There is no sexual difference in length or in diameter of facial hairs until after the tenth year of age. After the tenth year the length of the facial hairs in the male greatly exceeds the length of the facial hairs in the female. The facial hairs of women of the white race slightly exceed those of the colored race in length. After the tenth year the diameter of the facial hair in the male greatly exceeds the diameter of the hair in the female but the smaller hairs in comparable regions of the face in the two sexes are similar throughout life. The hairs of the white race show a greater average thickness than the hairs of the colored race. In both sexes of both races the upper lip is the region showing the most constant tendency for vigorous growth of hair. There is no constant difference in length or in diameter of hairs of dark haired women and light haired women, but dark haired women often seem to have a heavier growth of facial hair chiefly because of deeper pigmentation.

INHERITANCE OF A PIT IN THE SKIN OF THE LEFT EAR. By Kindred (James E.)—*J. Hered.*, 1921, XII, No. 8, 366-7.

The author reports a "pit" in the ear occurring in the skin in the region of the proximal end of the helix. (For a report on the same anomaly see Oliveira, J. M., *Am. J. Phys. Anthrop.*, 1922, V, No. 1). "The pitting occurs in some individuals of each generation from the time of its appearance and may be transmitted by individuals not marked themselves. Further, it may be transmitted by either sex. In some cases the offspring of unpitted parents are pitted, while in other cases the pit does not occur in the offspring of a mating in which one or the other of the parents is pitted. Judging from the manner of its appearance, the marking is neither dominant nor recessive, but must fall into the intermediate doubtful class of incomplete dominance."

A NOTE ON THE RELATION BETWEEN THE WEIGHT OF THE THYROID AND THE WEIGHT OF THE THYMUS IN MAN. By Scammon (Richard E.)—*Anat. Rec.*, 1921, XXI, No. 1, 25-27.

The figures indicate that any correlation which may exist between the weights of the thyroid and the thymus is inconstant in postnatal life, and they offer little if any support to the concept of a direct functional relation between the two organs.

HORIZONTAL AND VERTICAL PANCREAS IN ASSOCIATION WITH OTHER DEVELOPMENTAL ABNORMALITIES. By Bell (Howard H.)—*Anat. Rec.*, xxiii, No. 5, 315-319.

Two instances of anomalous form of the pancreas, the first in a white male child four months old, the second in a male still-born at term.

"The first specimen resembles the pancreas of the dog and cat in that it has a horizontal and a vertical process, although it has in addition an annular process. The position of the pancreatic ducts in this specimen would indicate that the annular part developed from posterior budding and the horizontal and vertical processes from anterior budding.

The second specimen was associated with many unusual abnormalities. The horizontal and vertical processes were in apposition on the summit of the gastric diverticulum, although no fusion had taken place."

## NOTES

The *Institut de Paléontologie Humaine* in Paris was formally opened December 23, 1920. *L'Anthropologie*, 1921, XXX, Nos. 5-6, pp. 561-573, brings the details of the inauguration with several good illustrations showing the building and parts of its interior. The establishment and opening of the Institute are events of the first importance to Anthropology, and this Journal is glad to extend its earnest wishes of success and development. Anthropology may and will expect much from the Institute, the foundation of which was made possible by the Prince of Monaco. The "Administrative Council" of the Institute consists of M. Dislère, President; Professors Boule and Verneau, and MM. Salomon Reinach, and Mayer.

*The Eugenical News*. With its issue of March, 1922, the Eugenical News, published monthly as a leaflet, advances to the status of a quarterly magazine as organ of the Eugenics Research Association. The subscription price is one dollar a year. (Address: Cold Spring Harbor, Long Island, New York).

### XX INTERNATIONAL CONGRESS OF AMERICANISTS

The American delegates who sailed for the Congress during July and the early part of August, were the following:

Dr. William L. Bryant, Dr. Mitchell Carroll, Col. D. C. Collier, Dr. Peter H. Goldsmith, Mr. Gilbert Grosvenor, Dr. Walter Hough, Dr. Aleš Hrdlička, Dr. Sylvanus G. Morley, Dr. M. H. Saville, and Dr. Herbert Spinden.

The English delegates, notice of whose sailing has been received, comprise Miss Adela C. Breton, Mr. W. J. Cooper Clark, Captain A. W. Fuller and Mr. Keith Henderson.

### GIUSEPPE SERGI.

In honor of the completion of the 80th year of the distinguished Italian anthropologist, the *Rivista di Antropologia*, (1920-'21, XXIV) appears in a special volume dedicated to Professor Sergi. The volume brings the following contributions:

*Sergi (Sergio)*—Sul piano orizzontale della visione; pp. 1-29, 6 figs.



*Giuliani (Luigi)*—Sui caratteri differenziali nel piano mediano fra dolico e brachimorfi; pp. 31-176, 4 figs., 7 pl.

*Sergi (Sergio)*—I muscoli intercostali e la differenza sessuale del tipo di respirazione nello cimpanzè; pp. 177-207, 8 figs.

*Patané (Michele)*—Contributo allo studio morfologico della microencefalia pp. 244-299; 4 pl.

*Marro (Giovanni)*—Microcefalia e diplegia; pp. 215-241, 1 pl.

*Sergi (Sergio)*—Studi sul midollo spinale dello cimpanzè; pp. 301-387, 3 figs., 10 diagr.

*Sergi (Sergio) & Maria Genna*—Sulla differenza del tempo di reazione semplice degli arti simmetrici; pp. 391-406, 1 pl.

*Battaglia (Raffaello)*—L'Evoluzione e il carattere dell'arte paleolitica nella Francia e nella Cantabria; pp. 407-438.

*Corso (Raffaele)*—Folklore; pp. 439-450.

*Angilello (F. P.)*—Di una dismorfia del basioccipitale; pp. 451-457.

*Croce (Gaetano)*—Sulla inclinazione dell'apofisi stiloide del temporale; pp. 459-463.

Dr. R. Verneau, Professor of Anthropology at the Muséum d'Histoire naturelle, Paris, has been promoted to the grade of Officer of the Légion d'honneur for distinguished voluntary services as a medical man during the war.

Professor W. H. Holmes, and Dr. Ales Hrdlička, have been elected Honorary Associates of the Sociedad Cubana de Historia Natural "Felipe Poey."

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## EVOLUTION OF THE HUMAN FOOT

—I—

DUDLEY J. MORTON, M.D.

*Milford, Conn.*

In the spring of 1921, the opportunity to dissect the feet of a young gorilla was extended to the writer, thru the courtesy of Professor William K. Gregory, of Columbia University and The American Museum of Natural History of New York. The subsequent study was carried on in conjunction with a general comparative analysis of numerous other types of primate feet. The writer desires to acknowledge his indebtedness to Professor Gregory, to Professor George S. Huntington of the College of Physicians and Surgeons of New York City, and to Mr. Herbert Lang of the American Museum of Natural History, for their interested co-operation and additional material for study.

The primate material used in this study, apart from the large number of human skeletons to which the writer had access, consisted of 4 gorilla specimens, (1 adult, 1 young and 2 infant), and the foot skeletons of the chimpanzee, orang, gibbon, macaque, cebus, propithecus, lemur, potto, galago, microcebus, tarsius, marmoset, baboon, and a partially restored specimen of the ancient *notharctus*.

The general comparative analysis dealt with variation in foot structure and consideration of the characteristic habits of the different species involved.

Highly specialized types furnish unmistakable evidence of the influence of the various methods of function in the development of the bony structure of the feet. Such development affords invaluable aid in interpreting the lesser differences observed in the more generalized types.

The writer, as an orthopedic surgeon, has been deeply interested in the study of the mechanical function and structure of the human foot for several years, also the architectural changes in bone resulting from

functional variation, or deformity. In order to obtain a more comprehensive understanding of the modern human foot, it became obvious that its previous, unspecialized form should be determined upon, as nearly as possible, and the process of its specialization be followed out from that point.

This introduced the much greater subject, "the Origin of Man," but the extensive work of scientists has clearly narrowed the field to Darwin's conclusions, i. e., that "some ancient member of the anthropomorphous sub-group (the anthropoid ape stock) gave birth to man." This conclusion is advocated by the majority of paleontologists and anatomists.

The problem, therefore, is focused upon the somewhat conflicting views of Professor Gregory, who would derive the human foot from one of a gorilloid type, and the opinion of Mr. Gerrit S. Miller, Jr., of the United States National Museum, Washington ("Conflicting Views on the Problem of Man's Ancestry") to the effect that "the distinctly human line branched off from the generalized primate stock at a point near that at which the line leading to the gorilla and chimpanzee originated and at a time when the great toe had not lost its "simply divergent character." The last phrase of this sentence is more definitely stated in a recent communication from Mr. Miller to the writer, as follows: "when the hallux had not been sufficiently changed from its original simply divergent condition to have been definitely started on the arboreal line of development."

When the individual bones and soft structures of man and the other primates are compared separately and collectively, the resemblance between man and the gorilla and chimpanzee is most striking; furthermore, prehistoric man has presented structural differences which are clearly intermediate between the modern human and modern anthropoid ape forms.

It seems to the writer that the apparent impossibility of deriving the human, highly specialized terrestrial foot from a type similar to the modern and known arboreal foot of the anthropoid apes, has been largely responsible for the diversity of opinion among scientists as to the origin of the human race. Dr. Gregory and Mr. Miller agree to the close relationship of the human and anthropoid ape stocks, but they disagree in that Dr. Gregory believes that the human foot could have been evolved from one of gorilloid type, while Mr. Miller is of the opinion that the gorilloid type of foot is too highly specialized for arboreal use to permit of change to the human form, because,—his observations on living primates lead him to believe that the arboreal specialization makes it impossible



for the highly modified foot of a great ape to function in a manner that would lead to development in the direction of the structure present in man.'

This paper will be devoted to the structural differences between the human and anthropoid ape types of feet, especially as concerns the variation toward the human form which appears to result from terrestrial use in the feet of the gorilla.

While foot skeletons of chimpanzees are not rare in this country, gorilla specimens are, and as the number of the latter which were available for this study, is too limited and the data too incomplete to establish proof of transition toward the human type in any one species of gorilla by means of terrestrial usage, nevertheless, the following findings will undoubtedly prove of definite value when and where sufficient specimens are available for more complete and exhaustive study. In the present case, the writer had the use of two infant gorilla feet of about the ages one-and-a-half and two years respectively, the two feet of "John Daniels"\* a gorilla of five-and-one-half years of age, and the feet of an adult gorilla. The species of each was unknown, as was also their native locality.

It will be noted that the infant specimens show more marked arboreal characteristics than the two older ones; this is especially so in regard to the grasping position of the halluces. The young gorilla John Daniels, which lived its life in captivity and had no opportunity of using its feet for other than terrestrial locomotion, showed, in addition to the reduction in the grasping position of the great toe, a definite decrease in length of the four outer digits.

The fact that the older specimens show a distinct variation toward human contour in the bones of their feet may be interpreted in two ways; first, that the known terrestrial habits of the adult gorilla produce these changes, (which are not of any extraordinary degree when compared with those changes which result from disordered function in the human foot or in other parts of the human frame); secondly, if these differences are laid to a range of variation in individual species, then it becomes evident that certain species show a closer approach to the human foot than has heretofore been recognized.

\*NOTE. "John Daniels" died in New York City during the spring of 1921. Its body was presented to the American Museum of Natural History by the Ringling Brothers Circus. It is the feet of this gorilla which are referred to at the beginning of this paper.

The greatest differences between the human and gorilla types of feet are the following:—

I. Opposability of the hallux—lacking in man.

II. The difference in the surfaces of the entocuneiform-metatarsal joint.

III. Disparity in the lengths of the respective digits.

In an interview with Mr. Lang, of the American Museum of Natural History, well known for his explorations in the Belgian Congo, the following account of the habits of these two animals was obtained. "During the period of growth both species are typically arboreal in their habits, but as the gorilla attains its full growth, it becomes more and more a terrestrial animal. The massive proportions of the adult are poorly adapted for the search of food among tree tops, consequently its diet becomes chiefly limited to roots, sprouts, and the fruit of such trees as it can tear down. This relatively unnutritious character of food produces in the gorilla a very ponderous abdomen, necessitated by the intestinal development required to properly digest and assimilate the needed amount of herbaceous material for a creature of this size. When the gorilla has passed a period corresponding to middle age in man, it is practically forced, by reason of its bulk and clumsiness, to live out its life upon the ground.

"The chimpanzee, in contrast, is more of an arboreal animal. The ratio of adult arboreal life in the two species might be estimated to amount to about 20% in the gorilla to 80% in the chimpanzee. The less bulky body proportions of the latter is undoubtedly influenced by a better selection of food consisting of fruits, kernels, eggs, occasionally insects and similar articles. It is more omnivorous in its diet than the gorilla, and its physical development which is more suitable for arboreal life, enables the chimpanzee to procure this more nutritious variety of food. In certain regions, where the red, fleshy fruits of a certain plant, the *Aframomum*, are abundant, the chimpanzee will remain on the ground for days at a time. However, the habits of this creature are arboreal by choice.

"In regard to the posture when on the ground, both chimpanzee and gorilla use an oblique, semi-erect position, with their knuckles in contact with the ground. This stooping posture is naturally induced by the heavy undergrowth of its native African forests. The distribution of body weight, especially in the gorilla, is chiefly borne by the short legs, as the weight of its enormous paunch is collected upon the pelvis. Only a comparatively small portion of weight is carried by the arms, as is

shown in the slight effort manifested when, on being agitated, the gorilla assumes a more completely erect posture, without support of the arms. The long arms are used more as a balancing support to the huge body than as a means of carriage.

"A complete bipedal gait, in the gorilla, without employing the arms, is but little used, and is an exceedingly unsteady and uncertain effort in the younger animals; the older animals, which have become accustomed to terrestrial life, can resort to this manner of locomotion with a fair degree of efficiency, but only do so for short intervals and when prompted by circumstances. At best, their gait is clumsy, shuffling and cumbersome, hardly comparable with the easy upright carriage of man."

The above account shows quite clearly the characteristic habits of these two animals, and the reasons for classifying the chimpanzee as an arboreal primate, and the gorilla as a terrestrial one. This classification is borne out by a comparison of the bony structure of their feet. The chimpanzee foot is distinctly arranged to furnish a firm grasp upon the rounded surface of the branches of trees to maintain effective balance of the body-weight, while at the same time supporting it or carrying it forward. The adult gorilla foot shows similar characteristics of structure, which, however, have been modified by increased terrestrial usage to a predominating extent, and in such a manner as to cause the foot to function like the human, i. e., supporting and propelling practically the entire body-weight over a flattened ground surface.

In considering the changes, and degree of change, to be looked for as a result of the alteration in the function from arboreal to terrestrial, in the gorilla foot, the influence of continued arboreal habits until a well advanced period of age must be borne in mind.

With this statement of the habits of these two anthropoids to show the distinct approach in the function of the gorilla foot toward that of man, attention may now be turned to the problems listed above.

*Opposability of the hallux.* Of the three problems, this is very clearly the most important. The literature and efforts to unravel the mystery surrounding the origin of man are conspicuous in the stress laid upon this one subject.

The question may properly be asked, "What is opposability?"

The human hand manifests this function as the ability to bring the palmar surface of the thumb in direct opposing contact with the palmar surface of the fingers or hand. Following the action slowly, it will be noted that in carrying the thumb across the palm, the thumb and first metacarpal move from the passive position in which its palmar aspect



is at a right angle to that of the fingers, traveling in an arc, they apparently rotate upon their longitudinal axis at the same time. This accomplishes a direct apposition of the two palmar surfaces.

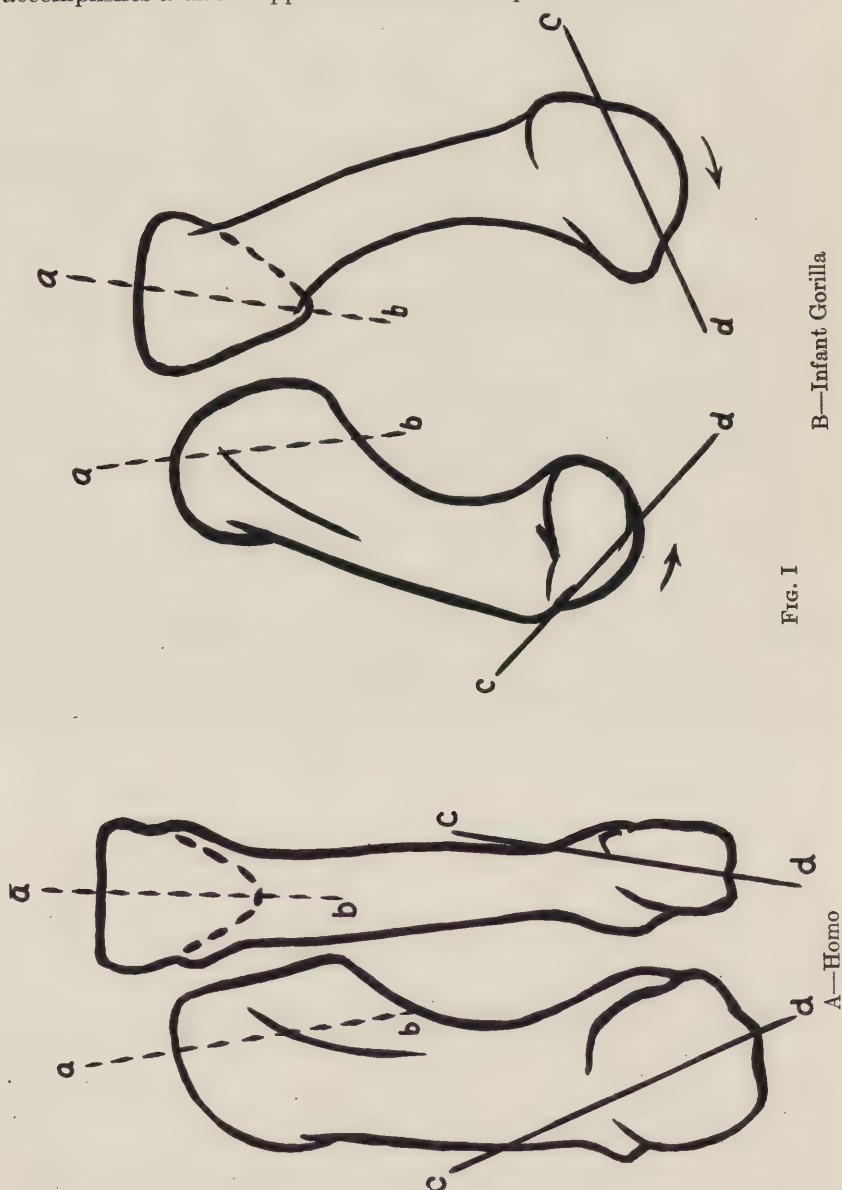


FIG. I

Such, then, is opposability as demonstrated in the human hand, but it is a very highly developed form, and not at all typical of the phenomenon as found in the primate feet. In the latter the cylindrical facet of the inner cuneiform does not permit the freedom of motion to the metatarsal which characterizes the movement of the metacarpal. The motion of the metatarsal is largely confined to the plane of abduction and adduction.

It must be noted, however, that in the primate foot, as in the human hand, the plantar surface of the hallux, like the thumb, is at a right angle to that of the digits. This tends to throw the plane of flexor-extensor movement of the hallux on the same plane with that of abduction and adduction of its metatarsal bone, with the result that, opposability as manifested in lower primate feet, is not a direct apposition of plantar surfaces, but a converging flexion of the hallux and the digits. Here, apparently, is presented the problem of untwisting the hallux  $90^\circ$  against its cylindrical basal joint, which absolutely determines its motions to carry in lateral directions only.

The solution lies in the fact that the right angle formed by the two planes of the hallucial and digital plantar surfaces, is not conditioned by the joint at the base of the first metatarsal, but by the conformation of all the metatarsals presenting a torsion of the shafts, or a rotation of the heads to varying degrees. The flexor-extensor axes of the four outer metatarsal heads are rotated so that their plantar aspects present toward the hallux, and that of the hallucial metatarsal is rotated in the opposite direction, carrying its plantar surface toward the digits; or, for example, in the right foot, as viewed from the heel, the heads of the outer metatarsals are rotated clockwise, while the hallucial metatarsal head is turned anti-clockwise.

The second metatarsal shows this torsion to the greatest degree in the specimens examined, the outer metatarsals (third, fourth and fifth) being involved to a lesser extent, as the dorsoplantar axes of their bases are already slanted outward because of the transverse arching of the tarsus. The hallucial metatarsal usually seems to be affected to about the same degree as the third.

This finding might be of little interest were not its importance so forcibly demonstrated in a comparison of the feet of three periods of gorilla life (infant, adolescent and adult) with adult human specimens. The accompanying diagrams indicate the position of the feet as determined by the leg bones being held perpendicular, but before the assumption of body-weight. (The arboreal foot is characteristically a supinated

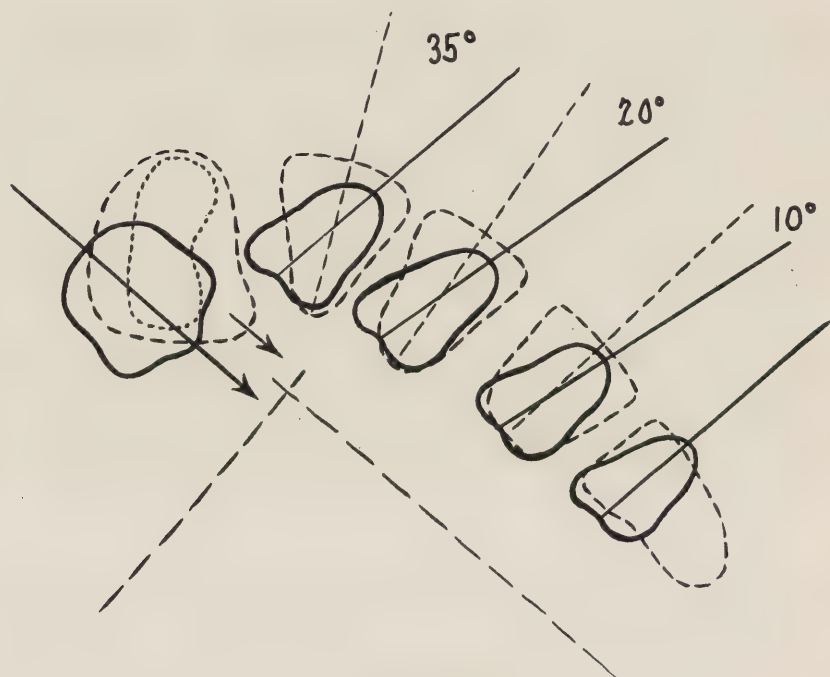
one). The amount of torsion is estimated by the angle formed by the flexor-extensor axis of the metatarsal head and the dorso-plantar axis at the base of the same bone.

The planes of the digital and of the hallucial plantar surfaces lie perpendicular to the flexor-extensor axis of the head of the respective metatarsal.

The chimpanzee shows about  $35^\circ$  torsion in the second metatarsal,  $20^\circ$  in the third, and  $10^\circ$  in the fourth, the fifth showing none.

The first metatarsal is distinctly different from that of the gorilla; in that, instead of a torsion, the entire bone seems to be remodelled so

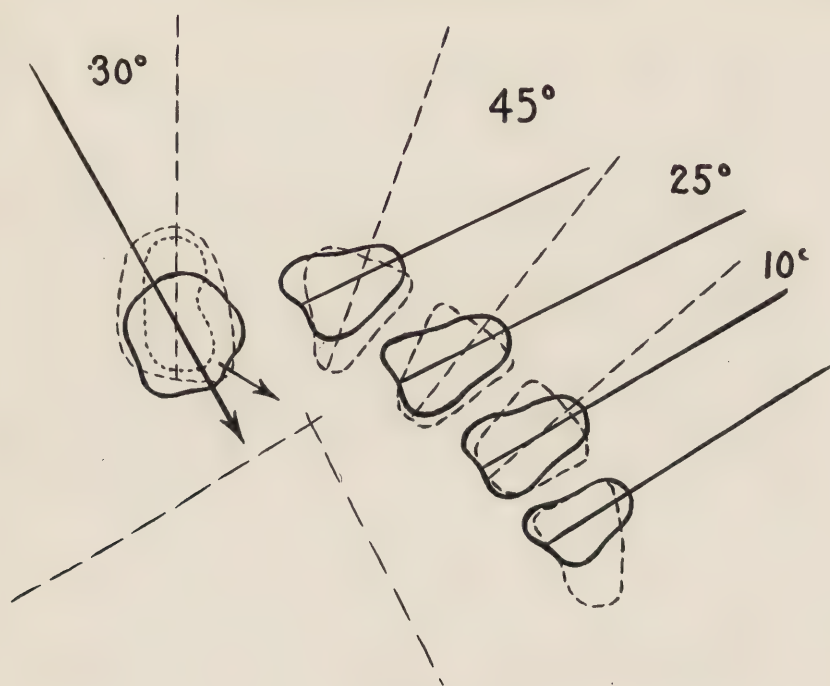
FIGURE II



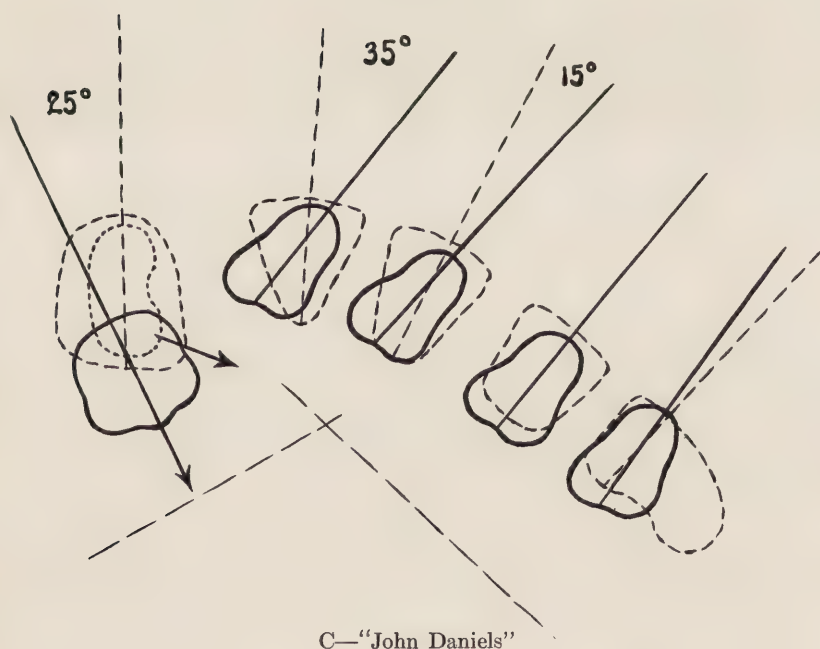
A—Chimpanzee

that even the dorso-plantar axis of its base lies practically in the same plane as the flexor-extensor axis of the head. This throws the pull of the long peroneal muscle into complementary action with the hallucial flexor, indicating the importance of the peroneal as a flexor or grasping muscle, and how completely adduction and flexion are combined in a single motion in the arboreal grasp. This arrangement in the hallux of

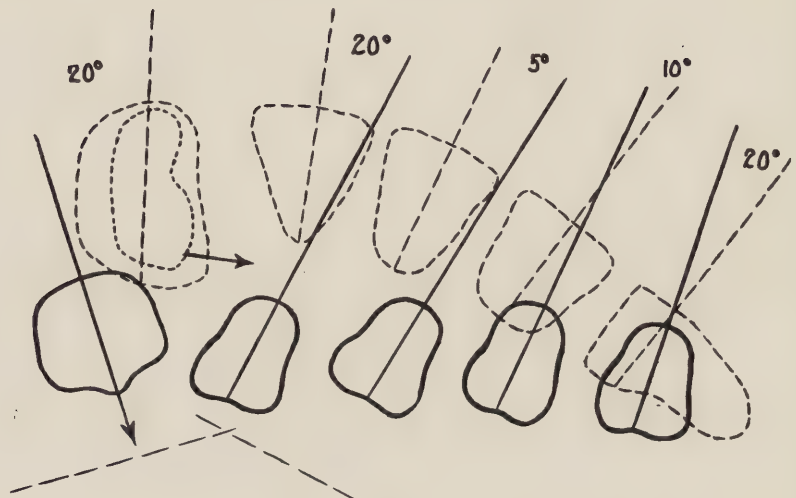




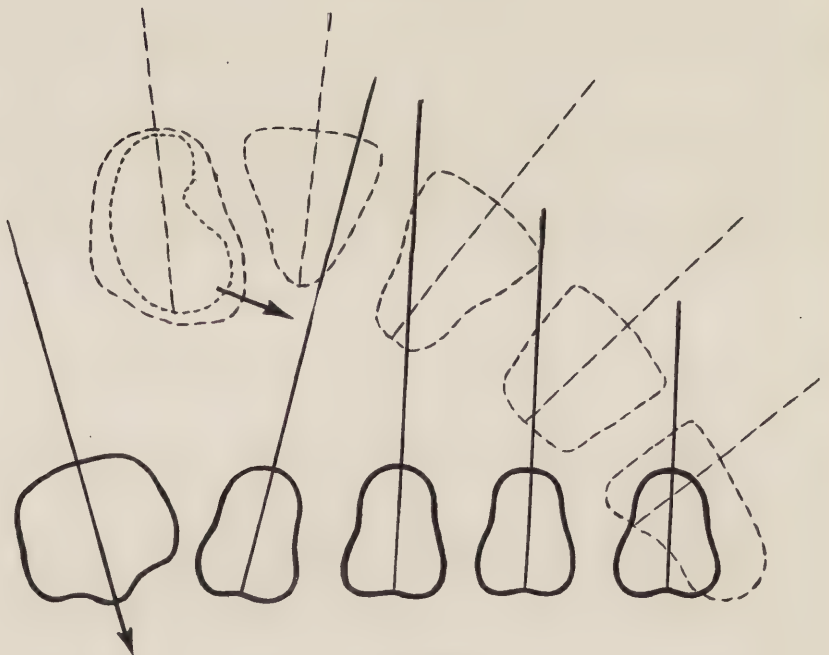
B—Infant Gorilla



C—"John Daniels"



D—Adult Gorilla



E—Homo

the primate foot is quite similar to that of the thumb of the human hand, lacking only the freer movement of the first metacarpal.

The plantar surfaces of the hallux and digits lie at a right angle to each other, as in the passive position of the hand.

The *infant gorilla* shows more marked torsion than the chimpanzee, amounting to about  $45^\circ$  in the second metatarsal,  $25^\circ$  in the third,  $10^\circ$  in the fourth, and none in the fifth. The first metatarsal, instead of presenting a dorso-plantar axis at the base which appears to continue as a prolongation of the line of pull of the peroneal, as in the chimpanzee, and not having the same marked growth of the peroneal tuberosity, shows an almost perpendicular dorso-plantar axis of the base, with which the axis of the head forms an angle of torsion of about  $30^\circ$ .

The relative position of the plantar surfaces seem to lie slightly within a right angle.

The pull of the peroneus is distinctly divergent (about  $25^\circ$ ) from the plane of flexor action of the hallux, but still remains within an arc sufficiently small to afford the advantage of their combined action for efficient arboreal usage.

The *young captive gorilla*, which had been deprived of its normal arboreal habits, presents some interesting changes. The metatarsal torsion noted in the infant specimen is distinctly reduced. The second metatarsal shows  $35^\circ$  instead of  $45^\circ$ , the third  $15^\circ$  instead of  $25^\circ$ , there is none in the fourth, while the fifth shows a definite angulation to the opposite (inner side) of the dorso-plantar axis of the base, whereby the plantar surface of this digit is brought more in contact with the ground. The torsion of the first metatarsal is likewise decreased, and the angle of the pull of the peroneus is in a plane fully  $45^\circ$  from the plane of the hallucial flexor.

The peroneal tendon is definitely attached to the outer lateral, and not the inferior, margin of the metatarsal base.

The planes of the plantar surfaces show a slight widening in the previous right angle.

In the *adult gorilla* the above changes take more definite form. The second metatarsal torsion is reduced to  $20^\circ$ , the third to  $5^\circ$ , the fourth shows an angulation to the inner side of the axis of the base, noted only in the fifth metatarsal in the younger gorilla, and in the adult fifth metatarsal this angle has increased to  $20^\circ$ . The torsion of the first metatarsal has continued to decrease so that the planes of flexor action and the peroneal pull are widely separated.

The plantar planes, which originally formed a right angle, are, by their marked widening, definitely approaching the common plane charac-



teristic of the human foot. There still remains the original ability to abduct and adduct the hallux, but opposability, as generally displayed by the primates, determined by the relative position of the plantar surfaces, is unmistakably modified.

Carrying the comparison to the human foot, it will be seen that here an appreciable amount of this torsion exists in the first and second metatarsals. The elevation of the arch, increasing the outward slant of the axes of the third, fourth and fifth metatarsal bases causes a corresponding increased angulation to the inner side by the respective axes of the heads and bases, a condition which can very logically be considered a continuation of what has already been noted in the gorilla feet.

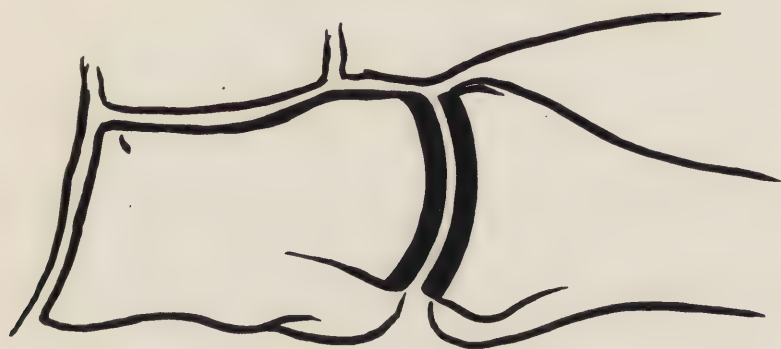
It seems quite remarkable that so great a degree of change, or, if the term be permitted, correction in an arboreal foot towards a bipedal terrestrial one, should be accomplished within the life span of the gorilla. While the hallux does not reach the state of being simply divergent without torsion, nevertheless, the process shown lacks only time to fulfill such a condition, or the stimulus of a suitable change in environment, or in the character (psychic or otherwise) of the species. This still leaves the reduction of the power to widely abduct the hallux to be accounted for in converting the gorilloid foot into human form, which will be considered under the following heading and later.

*The ento-cuneiform-metatarsal joint.* Mr. Miller, in the same article, denies the probability of a gorilloid, cuneiform bone being remodelled to present a facet comparable to that in man, and accompanies his arguments with the finding of Professor Leboucq in human embryos.

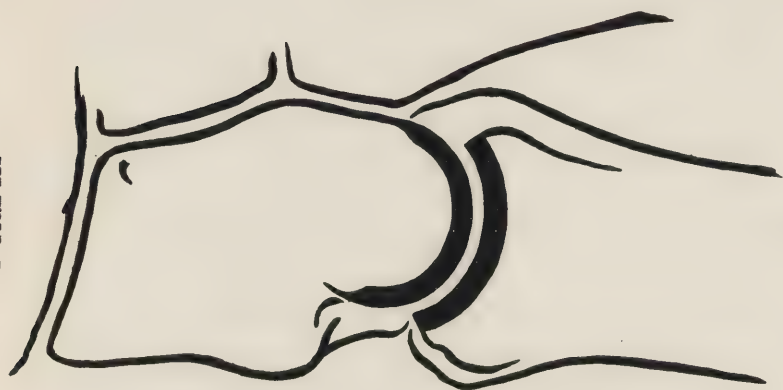
While concurring with Mr. Miller's opinion that the stance of a very young gorilla and the chimpanzee (whose feet the young gorilla's very closely resemble) is greatly aided by a wide divergence of the hallux, thereby securing greater stability, the writer would call attention to the fact that the foot of the chimpanzee is typically an arboreal one and never affected by the same degree of terrestrial use, and carriage of such weight, as is observed in the gorilla; also, that the posture of the foot of the immature gorilla cannot be considered the same as that of the adult, which has attained a relatively high degree of efficiency in terrestrial locomotion and stance.

Increase in efficiency, which must be admitted as the result of gradually increasing use of terrestrial locomotion, should cause the hallux to assume a position which would augment the propulsive efforts of the foot. This would mean a lessening of the abduction which would become more and more habitual. The reason for this will be taken up in

FIGURE III



C—Cebus



B—Gorilla



A—Homo

detail later in this study. It is mentioned here to indicate that, as the foot assumes more definitely and permanently the function of a bipedal organ, the medial (inner lateral) portion of the facet is decreasingly used, and would, therefore, become correspondingly reduced or atrophied. That such a deduction is probable and possible, and not merely based upon theory, is shown in a specimen of South American monkey (*Cebus*, A. M. N. H. No. 14016) in which, except for less abrupt edges, the facet and bone are almost identical with the human form, the articulating surface being distinctly flattened and limited to the anterior aspect of this bone. (Fig. III). It is important to note that this *Cebus* specimen shows a localized chronic inflammatory condition of the shaft of the fifth metatarsal bone near the head, possibly produced by injury. There is absolutely no evidence of disease or injury of any of the other bones. The result of such a condition would be to cause the weight to be carried more on the side of the great toe, simulating the human method. The opposite foot did not show the same flattened joint surface.

A transformation of this sort could not be expected in the gorilla, because its arboreal proclivities persist until late in its life, but the case cited above and obtained from within the primate group, excludes the impossibility of such a remodelling of this bone and joint.

FIGURE IV



Embryo Findings—Leboucq



In regard to the human embryological findings of Leboucq, in which he shows that the joint between the inner cuneiform and the metatarsal of the hallux at this early stage' (embryos from 20 mm. to 40 mm. in length) 'lacks gorilloid modification,' the influence of the high degree of specialization in modern man must not be ignored. The alteration in function from an arboreal grasp to terrestrial bipedal locomotion, is a profound change, and when the prior function is completely given up, the remodelling influences for the newly adopted function become intensified and will increasingly obscure structural evidences of the previous function, even in the early embryonic stages.

So complete is the specialization of the modern human foot, that it is not only incapable of any other than its characteristic function, but also, the foot at birth presents the same highly developed form for the erect attitude. This posture is used from early infancy, just as soon as the child acquires sufficient co-ordination of muscle action.

At present no formula has been devised whereby the changing features of a prenatal picture and the time of their appearance, disappearance, or non-appearance, can correctly disclose the period and character of structural changes as they existed in the early history of a species. Such a formula would be based upon: (a) the degree of alteration in function, (b) the proportionate use of the previous and the newly adopted functions, (c) the original structure, (d) the intensity of the forces affecting the parts, (e) the rapidity of the change in function, and (f) the degree of specialization ultimately attained.

The early appearance and disappearance of the premaxilla in the human foetus indicates the rapid eradication of an early characteristic under the influence of a notable alteration or specialization in development, as results in the extreme retraction of the jaws of the human skull; in the higher anthropoids, with the more primitive skull contour, fusion of the premaxilla and the maxilla is not completed until well after birth. On the other hand, the similarity in the chimpanzee, gorilla and man, in contrast to other primates, of the reduction of the fossa subarcuata of the temporal bone, which is not involved in so great a change in contour of bone, very clearly implies a close relationship between man and the two greater apes.

Consequently, in the absence of any means of determining accurately the proper interpretation of the embryological picture, the findings of Leboucq have no value in disproving the possibility of derivation of the human cuneiform from one of gorilloid type. In fact, combining

other embryological findings in connection with the cited *Cebus* development, the evidence distinctly favors the probability that this has occurred, and that the extended period of time and high degree of specialization has brought about the complete obliteration of the original form of the cuneiform bone at the period in which professor Leboucq's specimens were examined.

*Disparity in the lengths of the human and gorilloid digits.* On first viewing a gorilla foot, one is immediately struck with the comparative shortness of the hallux and the extra length of the third digit. The various lengths of all the gorilla digits would seem to complicate their reduction to conform to the human type.

Starting with the hallux, measurements of the combined lengths of the first metatarsal and hallux in a number of human feet shows this to be just about 50% of the total length, or, one-half the distance from the tip of the hallux to the heel; in other words, the ento cuneiform-metatarsal joint lies at the center of the inner border of the foot. The condition in the gorilla proves to be about the same, indicating that it is not necessary to lengthen the hallux, but to shorten the other digits.

The actual lengths of the digits, in centimeters, were as follows:

	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>	<i>V</i>
Infant gorilla.....	3.1	4.6	5.5	5.5	4.5
Young gorilla (Captive).....	4.1	5.8	6.7	6.6	5.4
Adult gorilla.....	5.5	9.0	9.9	9.5	7.9

Calculating the percentage of growth of the individual digits as shown in the two older specimens, the results obtained are:

	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>	<i>V</i>
Young gorilla (Captive).....	.32	.26	.22	.20	.20
Adult gorilla.....	.77	.96	.80	.75	.75

This shows an entirely different development in the two specimens. In the older gorilla the greatest growth is in the *second* digit and by a large percentage; in the third, it is much less, but distinctly more than in the hallux. Incidentally, the proportionate growth of the second to the three outer digits points clearly to a tendency of reduction of the three outer digits even in the native gorilla, to conform more closely to the human arrangement; that is, the longest third, or middle digit, also the fourth and fifth digits, (all three are of marked disproportionate length to those of the human foot), do not attain the same degree of

FIGURE V



A—Chimpanzee





B—Infant Gorilla



C—Adult Gorilla



D—Homo



growth as the second, which was much shorter than both the third and fourth in the infant gorilla, and about the same length as the fifth.

The young gorilla, which, as a captive, has been deprived of its early arboreal habits and the influence these habits would have upon the development of its feet, and being restricted to terrestrial use of the feet only, shows the highest percentage of growth in the hallux, which is very appreciably in excess of that of the second digit. Comparison of the relative growth of these two digits in the two specimens shows an almost startling disparity in growth, which can only be laid to the early alteration in function in the younger.

If the ratio of growth, as given in the captive gorilla, were continued until the hallux had attained its full 77% which the adult attained, the percentage resulting in the other digits would be, in order, 63%, 53%, 48% and 48%. This is vastly different from the figures obtained in the native adult gorilla. The actual measurements, in centimeters, resulting, for comparison, would be:

	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>	<i>V</i>
Adult Gorilla: Native.....	5.5	9.0	9.9	9.5	7.9
Non-arboreal.....	5.5	7.5	8.4	8.2	6.7

The reason for the shortening, or retarded growth of the digits in the captive gorilla is not difficult to understand. In an arboreal grasp, the digits play a highly important role, and their efficiency in this function corresponds to their length, in so far as the latter enables the animal to obtain a firm and secure hold upon the supporting branch, in association with the action of the hallux. On the ground, the long arboreal digits are useless and, in fact, an actual encumbrance.

For a moment consider the human foot. The toes have their extensor-flexor plane perpendicular to the ground. This enables them to give a snapping, propelling impulse to the body-weight as the foot leaves the ground.

When the arboreal foot is placed on the ground, however, owing to the torsion of the metatarsals previously described, the digits are partly turned to present their outer lateral aspects, instead of their plantar surfaces, to the ground; this position is exaggerated because of the usual semi-flexed passive attitude of the grasping digits, which throws them more completely on their side when in contact with the ground. This produces the sprawling appearance of the digits to which Mr. Miller has referred.

FIGURE VI



This attitude most effectively removes any possibility of practical usefulness of the digits in terrestrial locomotion, and such a suspension of function, if continued to any extent, will invariably result in underdevelopment or atrophy. In brief, a stage of relative uselessness of the outer four digits puts a premium upon the resulting process of shortening, so that they can become effective in the human fashion.

As a matter of interest, a further application of this formula was carried out, alternately reducing the non-arboreal results obtained in the adult, to infant measurements, using the hallux as the basis,  $\frac{3}{5}\frac{1}{5}$  (i. e., applying this fraction to each digit to obtain the same proportion of shortening in each infant digit) then multiplying the results by the non-arboreal ratio of growth of each respective digit plus 1.00, which represented its re-estimated infant length.

The results of this calculation, in centimeters, are as follows:

	<i>I</i>	<i>II</i>	<i>III</i>	<i>IV</i>	<i>V</i>
Non-arboreal results as above	5.5	7.5	8.4	8.2	6.7
1st Reduction	3.1	4.2	4.7	4.6	3.8
1st application of Formula	5.5	6.8	7.2	6.8	5.6
2nd Reduction	3.1	3.9	4.1	3.8	3.1
2nd application of Formula	5.5	6.3	6.2	5.8	4.7
3rd Reduction	3.1	3.6	3.5	3.2	2.6
3rd application of Formula	5.5	5.8	5.4	4.9	3.9
4th Reduction	3.1	3.3	3.0	2.8	2.2
4th application of Formula	5.5	5.3	4.6	4.1	3.2
Stage between 3rd and 4th application	5.5	5.6	5.0	4.5	3.6
					) Present range ) human foot.

The last two lines of figures (the fourth application of the formula and the half-way stage between the third and fourth applications) quite fully cover the range of proportionate length of the toes in man to-day.

The abrupt change shown in this tabulation could not be supposed to be characteristic of Nature's manner of performing it, because of the powerful influence of "reversion to type in off-spring;" but, that a ratio of digital growth obtained in a non-arboreal gorilla foot should, by



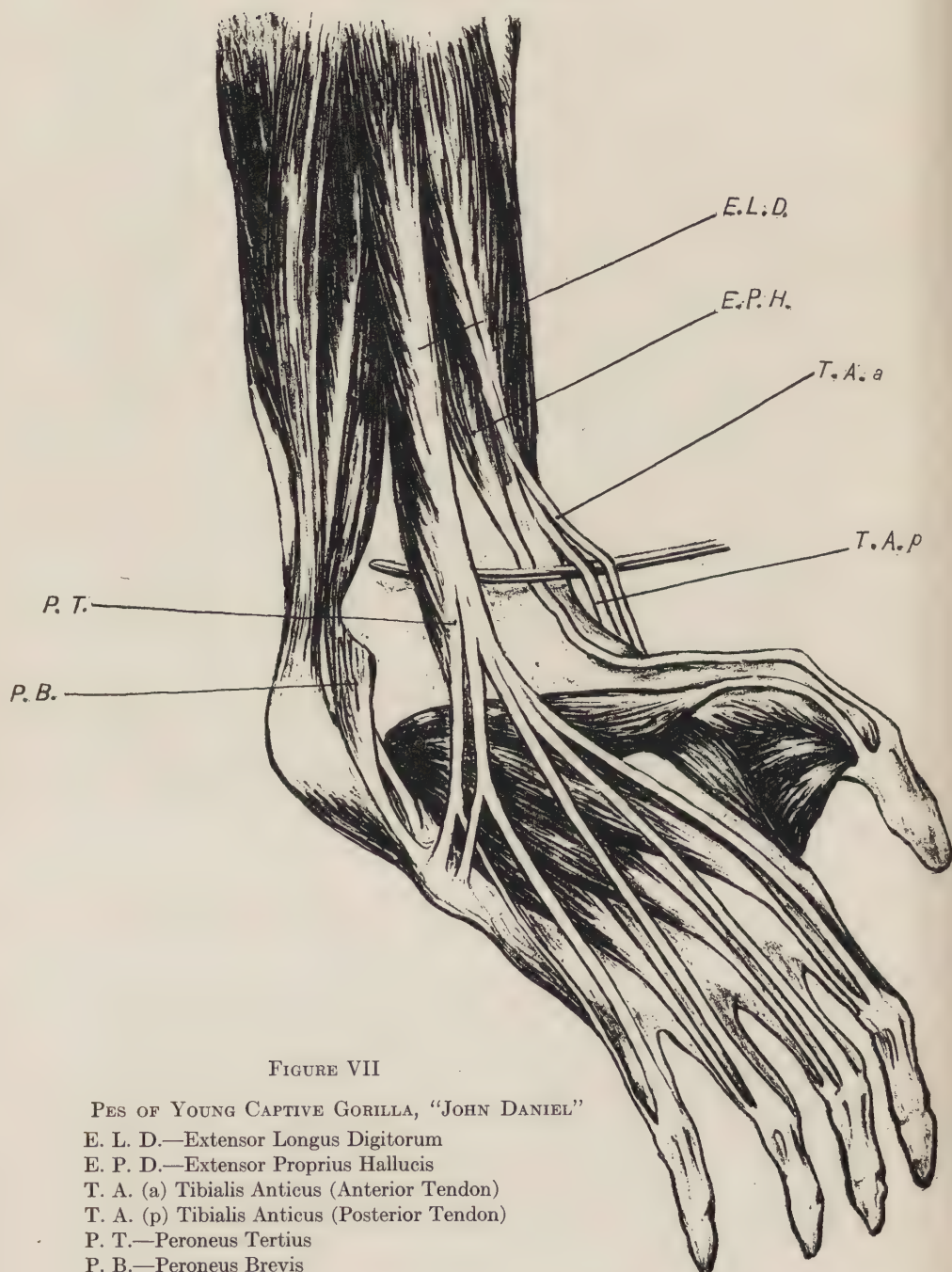


FIGURE VII

PES OF YOUNG CAPTIVE GORILLA, "JOHN DANIEL"

E. L. D.—Extensor Longus Digitorum

E. P. D.—Extensor Proprius Hallucis

T. A. (a) Tibialis Anticus (Anterior Tendon)

T. A. (p) Tibialis Anticus (Posterior Tendon)

P. T.—Peroneus Tertius

P. B.—Peroneus Brevis

repeated application, conform its proportionate digital lengths to comply with those of the human foot, certainly establishes the possibility of the actual change.

This ratio of growth can be considered constant, in so far as the terrestrial use of the foot is employed, and the rapidity of its action would be progressive and accumulative according to the habits of the species. Modifications are to be considered, and examination of a greater number of specimens may alter the formula somewhat, but as it stands the results are highly significant in this feature, as well as the others, that the human foot has been derived from one of gorilloid type.

As an additional bit of evidence which might be presented before closing, one of the most suggestive findings in the gorilla dissection, was the disclosure of a distinct *Peroneus Tertius*, a muscle which is supposedly limited to human musculature. As shown in the accompanying illustration, this muscle had common origin with the lower portion of the belly of the *Extensor Longus Digitorum*, its tendon springing from the common tendon. A distinct bundle of muscle fibres followed this peroneal portion of the tendon well below the point of separation.

There were two points of insertion; one, by a flattened tendonous band to the outer side of the base of the fifth metatarsal, the other, by an almost thread-like tendon to the outer side of the fifth digit in a manner similar to the insertion of the *Extensor Brevis* tendons to the second, third and fourth digits. This muscle and tendon was an entirely distinct structure from that of the Long extensor to the fifth digit, after separating from the latter beneath the annular ligament.

In comparison with the above, Piersol's note on the variations in the human *Peroneus Tertius* is interesting: "The *Peroneus Tertius* is quite frequently absent, and is usually more or less closely united with the *Extensor Longus Digitorum* above. Its tendon sometimes splits into two portions, the additional one passing either to the fifth toe or to the fourth metatarsal." The similarity, herein presented, to the findings in this dissection, is a striking one.

Another condition, which is quite constant in the anthropoids, is the division of the *Tibialis Anticus* tendon, and also, to a varying extent, the muscle itself. The larger portion inserts into the scaphoid, the other into the base of the first metatarsal. A similar division of the human *Tibialis Anticus*, but chiefly limited to the tendon, is found in about 10% of human specimens, according to Professor Huntington.

Through the courtesy of Professor Ferris of the Yale Medical School, the writer found by dissection that the transverse ligament of the human

foot, to which Mr. Miller refers, completely binds only the second, third, fourth and fifth metatarso-phalangeal joints, with merely an extension toward the hallucial joint. This finding was verified in a second dissection and is shown in the accompanying illustration, Fig. VIII. The transverse ligament, as it is followed inwardly from the fifth digit, begins from the outer side of the latter as a definite fibrous flattened band, crossing the bases of the proximal phalanges and receiving fibers from their joint structures; at the inner border of the second digit it divides, sending an important bundle dorsally along the inner side of this

FIGURE VIII



Transverse Ligament

digit to fuse with its fibrous joint structure. The other portion extends its fibers radially into the intervening soft superficial structures between the bases of the first and second digits. This extension does not include nor cross the phalanx of the hallux as it does that of the fifth digit, nor does it show any attachment to the hallux except indirectly through the structures into which it extends. These findings clearly indicate that the fibers, which are projected toward the hallux, are of comparatively recent development and formed to include the hallux, which at an earlier period, had been capable of a considerable degree of abduction.

The problem now turns to a consideration of the length of time arboreal life prevailed among primates. It is universally admitted that all



primate feet, including man's, demonstrate arboreal characteristics in structure.

Was arboreal life universal and synchronous thruout the earliest members of the primate group? Does the evidence point to the few, unmultiplied and most ancient species of primate life adopting arboreal habits almost simultaneously, or does it favor the multiplication of terrestrial species which independently and at different periods took to the trees? To the writer it seems that just as the birth of man undoubtedly took place toward the close of pre-human arboreal life, the origin of the entire primate order took place after its precursors had become established in the trees. This conclusion has very considerable evidence of support.

*First.* The predecessors of the primate group were quadrupeds with very primitive type of feet. If, as terrestrial animals, they had given off numerous species from time to time which independently assumed arboreal habits, the distinctly terrestrial, quadrupedal development of originally primitive feet prior to the ascent, would most surely have created a greater range of variation among the feet of primates than now exists. It might not be unreasonable to expect that there would be living primate species whose foot structure showed no arboreal taint.

*Second.* In contrast to the above, the known foot of the very ancient *Notharctus* shows well developed arboreal characters, and the feet of ground apes disclose their ancient arboreal ancestry which extended over so great a period of time that the terrestrial quadrupedal specialization which has followed, has failed to obscure the arboreal stigmata. Man, the most proficiently developed mammal for Bipedal stance and locomotion on the ground, and whose feet are most highly specialized for this use, displays distinct evidence of earlier arboreal life. The evidence referred to, is of the most advanced nature in the writer's opinion, and comprises the two following distinctive characteristics; first, the line of weight carriage being directed between the first and second toes, and second, the actual arrangement of the body frame for the erect attitude.

One of the most important results of arboreal life among primates is the grasping function of the foot, whereby the line of weight carriage over the foot is established along a line between the hallucial and digital portions of the foot, instead of over the heads of the middle metatarsals, as in the primitive foot. The smaller species, which are all distinctly quadrupeds, use the more primitive mode of carriage when on the ground and upon larger branches. The constant employment of the

inner line of carriage is restricted to the gibbon, chimpanzee, gorilla and man.

The next point for consideration is, that if early primate life was universally arboreal, how long were the ancestors of man involved, and to what extent were the feet affected by arboreal specialization?

The chimpanzee foot is the most generalized primate type among the great apes, and does not greatly differ from the generalized form among the smaller monkeys, except for its size. It may be considered as almost of a primitive type except for the changes which permit of its grasping function. The chimpanzee is an arboreal animal, and its feet lack any marked degree of specialization such as are scattered thruout the primate order, as in the tarsius, galago, ground apes, gibbon, orang, etc. The entire body structure, however, shows a great change from that of the original primitive quadruped and a very notable approach toward the human frame. Moreover, its gait is distinctly a semi-erect one and cannot be considered of a real quadrupedal type.

This strongly indicates, in view of the foregoing, that an indefinitely long period may be spent arboreally without extreme specialization of the foot if it is used in a comparatively diversified manner, and that a lengthy period of arboreal life is necessary to readjust the frame to a natural upright stance. It must be admitted that arboreal life offers the ideal opportunity to promote the frequent employment of the erect attitude, the development of the sense of equilibrium, the increasingly habitual use of the erect attitude and the subsequent readjustment of the entire structure.

With the exception of clawed animals which are familiar with climbing, or arboreal life, and the leaping animals with well developed hind quarters, terrestrial mammals offer few examples of a natural employment of the erect attitude, even to the extent of squatting with the forefeet free of the ground. The great majority of such squatting mammals are known to have arboreal habits to an appreciable extent. Those, to which such habits may not be ascribed, are so closely allied by family to the former, that common ancestry, which was at least familiar with arboreal life, is a very plausible possibility. This may even apply to the aquatic forms among the Rodentia, such as the beaver.

In marked contrast to the relatively few terrestrial mammals who use the erect squatting posture, is the universal employment of that posture among the truly arboreal animals, and the terrestrial descendants of ancient arboreal groups; for example, the ground apes. Throughout the primate order, which is notably the most typically arboreal group among mammals, the squatting posture is characteristic. More than

this, the primate order furnishes, in addition to man, two instances of erect bipedal locomotion, the gibbon and the propithecus, while the terrestrial posture of the gorilla, chimpanzee and also the orang is clearly semi-erect; and in the trees, they assume more definitely the erect position as the natural one.

There are no terrestrial conditions capable of counteracting the physical disadvantages of the quadruped in a way to encourage the erect attitude such as undeniably prevails in arboreal life. How, then, can the modification of the human frame for the erect attitude be accounted for, other than by a most extended period of habitation in the trees prior to the ultimate adoption of terrestrial life?

The following seems to the writer to be a logical interpretation of existing evidence regarding primates and the erect posture. The earliest primates, represented as a comparatively restricted group, were arboreal quadrupeds. Their habits caused the development of a grasping function in all four extremities and produced sufficient changes of the nervous system and body as to enable the squatting posture to be naturally assumed. Thus, there appeared the quadrumana. At quite a remote period certain groups of these quadrumana, the Cercopithecidae, descended to the ground. They used a quadrupedal gait in the trees and continued to do so upon the ground. Their previous arboreal life had failed to accomplish more for them than the attainment of an erect squatting posture, in so far as the erect attitude is concerned, and this they have retained. In their feet the primitive method of carrying the bodyweight over the middle metatarsal bone was still used, with the result that terrestrial quadrupedal locomotion produced lengthening of these bones, comparable with that of other cursorial mammalian groups, with a corresponding lack of development of the hallux.

The present quadrumanous types undoubtedly present but little change from the earlier ones. Brachiating became adopted by more agile species and produced the suspension, hook-like grasp of the four outer digits of the hands, with their subsequent lengthening, which also involved the metacarpals. Atrophy, by non-use of the thumb in those species has distorted the hand to look like a hook, while the foot still retains the resemblance of a hand.

Another group in that distant quadrumanous period, the anthropoid ape stock, were attaining greater size. The increased weight debarred them from traveling along the avenues among the tree-tops in a cursorial manner, similar to smaller primates, and led to three conditions which greatly promoted the use of the erect posture: (a) brachiation; (b) living nearer the trunks of trees, which required a greater amount of erect tree-



climbing and other movements; and (c) the acquirement of larger feet, with longer digits, this facilitating a balancing grasp upon larger supporting branches and allowing freer use of the arms. The gibbon has become so dexterous in exploiting the first and third of the above conditions that it is not surprising that he has become an arboreal biped, nor that he *has so far surpassed the other* great apes in assuming the erect attitude on the ground. The writer has had the opportunity of observing two living adult gibbons, and one young one at the Bronx Zoological Gardens in New York City. The gibbon furnishes a remarkable example of the influence of arboreal life in accomplishing the erect posture. As for the three other members of this group, the orang, chimpanzee and gorilla, the erect position of the spine is certainly far more normal to them than the horizontal one, and apparently their customary attitude in the trees is with a vertical spine rather than the horizontal position of quadrupeds. Continued arboreal life has developed their upper extremities at the expense of the lower ones, (especially is this so in the orang), so that their attitude on the ground is an imperfect one.

The human line in the above interpretation would follow from the early arboreal primate stock along the anthropoid ape branch until such size of body had been attained as to insure a natural preference for the erect attitude for reasons given above, and to establish the line of weight carriage between the hallux and second digit. The feet would have been of a generalized gorilloid type, intermediate between the modern chimpanzee and gorilla types, and with some macaque features.

The general appearance of the species leading to the human stock at the time of the division from the great ape line would be as follows:

Brachiating and climbing, a period of which was necessary for the establishment of the erect posture, had lengthened the arms and slightly deformed the hands (elongating it and reducing the thumb) but not nearly to the extent presented in the modern gorilla or chimpanzee. (It must be remembered that both of the latter have continued to develop arboreally all the while man has specialized terrestrially). The torso was deep-chested, long and with no lumbar lordosis. The legs were short, compared to modern man, but considerably longer proportionately than the gorilla presents, and were not heavily muscled. The calf muscles were not developed as those of the modern human, but were long and slender. The hips and knees were held somewhat flexed and the pelvis tilted backward.

The lesser disparity in the relative lengths of the arms and legs, as compared with modern great apes, tended to inhibit the employment

of the arms for terrestrial locomotion. If the arms were used, the attitude would have been more horizontal and quadrupedal in type than the semi-erect attitude of the modern apes, and if this had been persisted in, the creature would have reverted to a quadruped as the ground apes had done. Therefore, in order to prevent such a reversion, preference for the erect posture had to be firmly fixed by arboreal practice, so that when established, it would act as an extraordinary impulse to resist the resumption of the horizontal position.

According to this viewpoint, it does not become necessary to discover some unknown terrestrial factor which would raise a quadruped upon its hind feet, nor is it necessary to stretch our credulity by crediting a quadruped of extremely low degree of mentality, with sufficient power of cerebration to overcome its physical disadvantages, first finding employment for its forefeet, then, lifting itself upon its hind legs and exercising that position sufficiently to adopt it. In contrast to this, the above analysis explains an accomplishment of the erect terrestrial posture which is purely mechanical and absolutely independent of any mental effort on the part of the creature. The sense of equilibrium had been highly developed and the frame and tissues of the body extensively readjusted for and by the use of the erect posture while in the trees.

With the mechanical assumption of the erect attitude while on the ground, the creature was presented with two perfectly useful and powerful, but practically idle, members: his hands. The independent use of these would naturally follow, and probably no other factor had a greater influence in the development of mentality and the permanent adoption of terrestrial life, than the increasingly intelligent employment of the hands.

*Conclusion to Part I.* The two most important points to determine, in attempting to follow the course of evolution of the human foot are, how the erect terrestrial attitude was acquired by man or his forerunners, and what were the particular structural characteristics of the foot at that time.

As for the first question, the writer has attempted to show that a protracted arboreal life was essential, not only for training the primate to assume the erect posture naturally, and to remodel his body for this position, but, also, as a means to prevent a quadrupedal specialization for cursorial locomotion, and to establish the line of weight carriage between the first and second metatarsals.

In regard to the characteristics of the early human foot, if all the evidence has been correctly studied, they must certainly have been of a

generalized gorilloid type, with the grasping element well developed. Since the time when division from the human line took place, there has undoubtedly been increased arboreal specialization in the great apes, but this, in the writer's opinion, has principally affected the upper extremities, and only to a minor degree involved the feet.

The method of the loss of opposability of the hallux in the human foot seems, to the writer, to be demonstrated in these studies of the gorilla foot, and the reduction in the length of the digits, as a result of lack of arboreal function, seems to be very reasonably and logically disclosed by the feet of John Daniels.

The loss of the lateral extension of the entocuneiform facet and the reduction of its convexity, would be a natural result of disuse of the function of abduction supplanted by the transmission of violent forces moving in a plane at a right angle to the anterior portion of this facet. If the *Cebus* specimen had shown no disorder on the outer side of its foot, it might have been considered a chance or congenital deformity; but the presence of the local chronic inflammatory condition is visible evidence to the effect that bodyweight would be carried along the inner border of the foot, similar to the human method, and that, by so doing, a remodelling of this joint resulted, conforming it with the human contour.

In offering this preliminary study, the writer recognizes that too scant a quantity of material and data has been available to establish an actual proving of the original human or prehuman form of foot. Nevertheless the principal differences between the gorilloid and human types seem to be so reduced by the terrestrial usage of the gorilla foot, that modification of a distinctly gorilloid type appears to be the natural evolutionary source of the human model. The recognized close relationship between the great apes and man, and the interpretations of the dominating influence arboreal life furnished in establishing the erect posture, seems to bear out such an hypothesis.

Thru the kindness of Mr. Carl E. Akeley, of the American Museum of Natural History, and Dr. Gregory, a pair of adult gorilla feet were put at the disposal of the writer for dissection. These feet were obtained by Mr. Akeley in his recent gorilla-hunt in Africa for the Museum. Each foot presented a fully developed tendon of the *Peroneus Tertius* Muscle which had a strong attachment to the base of the fifth metatarsal anterior to that of the *Peroneus Brevis*. The muscle body seemed intimately connected with the *Extensor Longus Digitorum*. The well defined tendon in this specimen showed up in sharp contrast to the rudimentary one in "John Daniels."



## THE PILTDOWN JAW

ALEŠ HRDLIČKA

During his recent trip to Europe, and thanks to the courtesy of Dr. Smith Woodward, the writer was able to submit the original of the lower jaw of Piltdown to a detailed personal examination. This revealed a number of features which have either not been mentioned as yet or have not been enough accentuated in previous reports, and which throw further and it seems conclusive light upon the mooted question as to the human or non-human nature of the specimen.

The examination of the original bone impressed one once more with the great difference that exists between the study of a cast however well made and that of the original. It is very probable that some of the statements made about the jaw and the teeth and some of the conclusions arrived at by some authors, would not have been made had they been able to study the jaw itself.

The first strong impression which the specimen conveys is that of normality, shapeliness and relative gracility of build rather than massiveness. When, after studying the specimen for a good part of two days, the observer took in hand the thick Piltdown skull, there was a strong feeling of incongruity and lack of relationship, and this feeling only grew on further study. As a rule there exists a marked correlation between the massivity of the skull—particularly if as in this case the upper facial parts were involved in the same—and the lower jaw. A finely chiselled mandible of medium or sub-medium strength belongs as a rule to a skull that is characterized in the same way, and *vice versa*. To connect the shapely, wholly normal Piltdown jaw with the gross, heavy Piltdown skull into the same individual, seems very difficult. After prolonged handling of both the jaw and the skull there remained in the writer a strong impression that the two may not belong together, or that if they do the case is totally exceptional.

The next important question in connection with the jaw was whether or not it is human. All possible pains were taken to determine this point, regardless both of the skull and of previously expressed opinions. The details of this study will follow. But it may as well be said at once that all the results of the study point to the specimen being very early human or that of an advanced human precursor, and not anthropoid.

Other questions were whether the canine tooth found near the jaw belonged to it or not; and if it did not whether it could have belonged perhaps to the upper jaw of the same being or a being of the same variety. Upon these questions no absolute certainty could be reached; but the indications are that the jaw possessed a relatively large canine, and a further study of the tooth admits of the possibility that it belonged not merely to the same individual, but that after all it may be the lower right canine of the jaw. Mr. Miller, who in the writer's knowledge subjected the available data as well as the casts to a most careful study,<sup>1</sup> was at a disadvantage due to the impossibility of studying the originals.

#### DETAILED OBSERVATIONS

*The Jaw:* The specimen is in a very good state of preservation. Besides the well known lack of condyle and the alveolar arch anterior to the first molar, there is no other damage except a slight abrasion of the middle portion of the posterior border of the ramus.

The specimen is not heavy in weight nor massive in structure; it is marked in fact by relatively moderate build, strikingly at odds with both the first and second Piltdown skulls which in all their parts are decidedly thick. There is no perceptible correspondence between the jaw and the skulls.

The ascending ramus gives the writer the following measurements: Height along the middle to lowest point of notch—6.1 cm.;<sup>2</sup> minimum breadth (allowing for slight damage of the posterior border) 4.25 cm. The angle is close to 112°. These measurements show little that could be regarded as biologically distinctive and could be duplicated in man as well as in some chimpanzees.

The ramus, finely formed, is of only moderate strength. Both the processes, coronoid and condyloid (the condyle itself is lost), were of about medium human development and quite human in form. This is particularly true of the coronoid, which is sharper and pointing somewhat more forward than it generally is in the chimpanzee.

The notch between the condyloid and coronoid processes is broad and typically human in form; in chimpanzees it is as a rule less broad, its posterior portion predominates in length and it has lesser inclination than the anterior part.

<sup>1</sup> See Miller (G. S.).—The Piltdown Jaw. *Am. J. Phys. Anthropol.*, 1918, I, No. 1.

<sup>2</sup> The condyle, as well known, is missing; with the condyle and measured in the usual way (see A. Hrdlička, *Anthropometry*, Wistar Inst., Phila., 1921), the height of the ascending ramus would be about 7.0 cm. or slightly over.

Features of special interest are the neck of the condyle and the posterior border of the ramus. The neck of the condyle is rather short and decidedly more slender than it is in chimpanzees, and even in most male modern human jaws. Below the neck the posterior border is rather sharp and towards the angle shows slight inversion rather than eversion, as not seldom in chimpanzees where the internal pterygoid muscles predominate in "pull" over that of the masseter externally; the same condition may also be met in some humans where the masseters were not well developed.

That the masseters in the Piltdown specimen were not strongly developed is shown by the smoothness of the outer surface of the angle portion of the jaw which is free of insertion ridges or irregularities. Such a condition is occasionally approached in chimpanzees though there are usually plain indications of the attachment of the muscle; it is clearly approached in some human jaws. The internal pterygoid muscle, attached to the internal surface of the ramus between the mylohyoid groove and the angle of the bone, and serving essentially for protrusion, retraction and in lateral movements of the jaw, in the chimpanzees as a rule predominates in strength and hence marks of attachment over the masseter, and it does so also in a certain proportion of humans; but in many humans the extent of the attachment of the pterygoid, even though it may reach the mylohyoid groove is more or less reduced, and in not a few it is the masseter which predominates in strength producing a more or less marked eversion of the lower border of the bone at the angle. In the Piltdown jaw the attachment of the internal pterygoid, while reaching as far as the mylohyoid groove, left only faint traces of its attachments, less even than in many present day human jaws. Nevertheless, the masseter was evidently even weaker, due to which fact the border at the angle is slightly inverted as already mentioned.

The external surface of the ramus in the Piltdown jaw shows a marked and hitherto unmentioned depression produced by the body of the masseter. The depression begins superiorly just below the condyle and proceeds unevenly forwards and downwards to end in a large shallow concavity over the lower third of the ramus anterior to its middle. Of a similar depression there is found in the grown chimpanzees at most only the anterior portion. In human subjects this fossa is also frequently more or less deficient and irregular; nevertheless, there is on the whole a closer approach to it than in the chimpanzees; and in one of the skulls seen at the British Museum (Australian, No. 1068-4), as well as in several jaws at the U. S. National Museum, there is a very close approach to the condition such as seen in the Piltdown mandible.



The anterior border of the ramus is somewhat thicker and duller than it is in an average modern human jaw, especially in that of a cultured white man. It is near to the average border in a chimpanzee; but it is a feature of little diagnostic value, being an expression of strength and not derivation. An equally thick border may be found in some human jaws, while in some chimpanzees as in most modern humans the edge is thinner.

Internally the upper portion of the ramus shows nothing especially characteristic. The impression for the external pterygoid is faint, that for the temporalis well marked but of moderate extent. The ridges and depressions, and the location of the mandibular foramen with the hyoid groove, present nothing that is not fairly common in both man and the chimpanzees.

Taking the ascending ramus as a whole, the conclusion is inevitable that it belonged to an individual in whom all the muscles of mastication (internal pterygoid, masseter, external pterygoid as well as temporal) were of only moderate development and activity for a being of the size indicated by the jaw. They were decidedly less than those of actual male chimpanzees, and possibly even a trace less than the average in the females of this form. On the whole the ramus, while bearing some resemblance to that of a chimpanzee in the slight inversion of its posterior border about the angle and the thickness of the anterior border, shows a closer approach to the human type than to that of the chimpanzee.

*The Horizontal Part or Body of the Jaw:* The horizontal ramus of the Piltdown jaw, broken off superiorly in front of the first molar and inferiorly near the symphysis, shows a relatively light structure, comparable much more to a stronger modern human jaw than to that of a chimpanzee. The break shows that the ramus possesses a large cavity (which may have been partly filled by cancellous tissue) that reached without much diminution clear to and evidently through the chin. This condition differs markedly from that of the jaws of chimpanzees, in which the bone is thicker and the internal cavity smaller, particularly at the chin which is filled with sparse and dense cancellous tissue as hard as the compact walls outside of it, and in which the formation by natural means of a similar cavity as seen in the Piltdown specimen seems impossible. This is one more and an important feature, indicating a relatively light use of the jaw, less than in any known chimpanzees.

The body appears relatively somewhat low, which in man would indicate a female rather than a male individual; but it could also be a

primitive feature. Low bodied jaws are a general feature in the chimpanzees. The vertical height of the body in the Piltdown jaw at the first septum anterior to the first molar, is 3.0 cm; at the second septum (between first and second molars) 2.9 cm; and at the third septum (between second and third molars), 3 cm. In a series of male chimpanzees in the U. S. National Museum the height at the septum between the second and third molars on the right side measures respectively 2.75; 2.8; 2.4; 2.8; 2.65; 2.9; 2.8; 2.85; 2.65; and 2.9 cm. None of the chimpanzee jaws, although most of them are males and larger than the Piltdown specimen, measure even as much as it does in the height of the body.

The minimum thickness of the body (at first molar) of the Piltdown jaw is 1.45 cm. This is above the average of both human and chimpanzee jaws, but is occasionally equalled and even exceeded in both. There is therefore nothing distinctive in this respect.

The external surface of the body shows the usual somewhat indistinct *oblique line*. There is nothing characteristic in it for either man or chimpanzee. This external surface shows also however, an important feature that has so far failed to receive due attention. This is a basal ridge forming a boundary between the external surface proper of the bone, and the inferior flattening that gradually enlarging proceeds under the fore part of the jaw where it forms a shelf such as exists more or less in ape and other jaws that have a negative chin. The ridge above this shelf is not found in modern man except rudimentarily. It is already rather rudimentary in the Mauer jaw. It is well marked in the Piltdown jaw, and it is occasionally fairly well marked in an adult chimpanzee. It is caused by the shelf but even more so by the large and long canine eminence due to a large canine. It does not exist, or exists only in traces wherever the canine tooth is small as in the chimpanzee females and the young, or in modern man. Its presence in the Piltdown jaw seems a very strong indication that the jaw possessed a relatively large canine tooth; and this, with other considerations, increases the probability that the Piltdown canine belonged to the jaw, or at least to the same or a like skeleton.

The development of the sub-mentoneal shelf in the Piltdown jaw equals that of most chimpanzees—except, as already mentioned, in the solidity of the structure which in this case was plainly less than in any of the apes. A shelf of this nature is found in none of the ancient human jaws, though they all show traces of it. Traces of it may in fact be detected even in some modern jaws of man. In this feature,

and in the indicated presence of a relatively larger than human canine, the jaw stands apart from all those of early man that have so far been discovered, and is correspondingly nearer to the chimpanzee or some related ancient anthropoid form. But neither of these features can be taken as conclusively diagnostic of a chimpanzee nature of the jaw. All that we would seem to be justified in saying is that in these respects, as well as in one or two others, the bone resembles more that of an ape than man. But as we cannot but believe that the human lower jaw in its evolution must have passed through such stages, these features do not legitimately hinder us, if other characteristics so urge, from placing the jaw in the line of early man or his precursors.

The lingual surface of the body of the jaw is quite smooth and presents nothing distinctive for either man or ape except the height of the body which on the inside even more than on the outside approaches the human type. The height of the body from the middle of the lingual border of the 3M alveolus is 3.0 cm.; in the adult chimpanzees of the U. S. National Museum it was found to be respectively 2.8, 2.7, 2.8, 2.5, 2.75, 2.4, 2.6, 2.85, 3.0, 2.7, 2.6, 2.9, and 2.6 cm. In the Mauer jaw this height was 3.3 cm.; while in modern human jaws a height of 3 cm. or even slightly over is quite common in males; in females it is lower. If the Piltdown jaw represents a female, as seems most likely, the male jaw of the same species would have been even higher and well beyond the range of variation of the chimpanzee.

*The Teeth:*—The alveoli and interalveolar septa in the Piltdown jaw show little that could be regarded as distinctive in form; but they are larger antero-posteriorly, particularly in the case of the 3M, than in any chimpanzee available for comparison, coming much nearer the alveoli in some human mandibles with macrodont teeth. The total length in the median line of the three alveoli is 3.9 cm.; in the Mauer jaw it is 3.8 cm.; in some modern human jaws with large teeth it ranges from 3.6 to 3.9 cm.;<sup>3</sup> in the available male chimpanzees it varies from 3.1 to 3.4 cm.;<sup>4</sup> in chimpanzee females from 3.1 to 3.25 cm. The size of the three molar alveoli in the Piltdown jaw is plainly not chimpanzee-like, but stands close to early and macrodont recent human.

The breadth of the molar alveoli in the Piltdown mandible is just 10 mm. for each alveolus. This is also larger, and that by from 0.5 to 2.5

<sup>3</sup> Australian: 255, 715 U. S. N. M.—3.9; Peruvian Indian, 293, 249—3.7; New Britain, 226, 107—3.16 cm.

<sup>4</sup> Males: 84,635—3.3; 174,704—3.3; '710—3.; 176,226—3.1; '7—3.1; '8—3.3; '30—3.3; '35—3.3; '44—3.4 cm.

Females: 174,700—3.25; '1—3.2; '6—3.1; 176,229—3.1; '43—2.1 cm.



mm., than that of corresponding alveoli in any of the available chimpanzees,<sup>5</sup> but is equalled or closely approached in the Mauer (1M-10; 2M-10.5; 3M-10 mm.) and in some modern human jaws with large teeth (Australian, 255,715-1M-10.2; 2M-10.2; 3M-10.1 mm.; New Britain, 226,107-1M-10; 2M-10; 3M-10 mm.; Arkansas Indian, 262,587-1M-10; 2M-10; 3M-10 mm.; etc.)

The dimensions of the alveoli in the Piltdown jaw, together with the two remaining teeth (rM1, M2), show that the teeth were large. They were larger than any chimpanzee molars that are available for comparison. The Piltdown man or woman, like the jaw of Mauer and probably also other early human jaws (La Chappelle, La Quina), came therefore in all probability from a macrodont ancestry. As the bone mass and the musculature of the jaw are both reduced, the size of the teeth cannot be regarded as an individual peculiarity.

The two teeth themselves are naturally of much importance. They in a way resemble both the molars of some chimpanzees and those of some men. But they possess important characteristics that separate them from the ape teeth and approach them closer to human. They are somewhat more dolichodont (relatively long and narrow) than most human molars, but individual human teeth equalling them occur. In chimpanzees dolichodont molars are more frequent though there are also many exceptions; but in general the type of the crown in the chimpanzee is somewhat different.

The two anterior cusps in each of the teeth in the Piltdown jaw were stout and close together as in many human teeth. In the chimpanzees as a rule these cusps are smaller and farther apart.

In the chimpanzees the enamel part on the sides of the molars is lower (less in height) than in man; in the Piltdown jaw the conditions are about the same as in man.

In the Piltdown jaw, as occasionally in man, the enamel on the outside and slightly also on the inside extends in a pointed way towards the notch between the roots of the teeth. No such condition was found in the chimpanzees, though occasionally the limits of the enamel in their teeth are not easy to determine.

The crown of the chimpanzee molars in the majority of cases shows, particularly externally, a marked bulge just above the gum ("cingulum"), from which the cusps slope more or less upwards. Externally this slope

<sup>5</sup> In the strongly developed male #174,699 the alveoli for the first and right second molars just reached 10 mm., but those for the other molars in the jaw are slightly to markedly smaller.

is sometimes very decided. In man, and that in early as well as recent man, the bulge mostly becomes just a convexity and the cusps are more vertical, making the surface of the crown larger. In the Piltdown teeth conditions are exactly as in human molars.

The Piltdown molars are moderately worn down to the level of the depressions between the cusps. These depressions as far as preserved, and the wear itself, are very much as they are in man. In the chimpanzees such depressions show some differences from both the prevalent human and the Piltdown type, and the wear of the teeth is generally irregular. But there is a chimpanzee jaw of the National Museum series (#84,655) in which the wear is about the same as in the Piltdown and many human molars, and there are not infrequently human molars in which the wear will be irregular. Nevertheless, in this feature again as in other characteristics of the crown, the Piltdown teeth range themselves on the whole closer to human than to the chimpanzee type.

The crowns of the Piltdown teeth, in their height, find nothing resembling them in the teeth of the chimpanzee, but are closely like those of both early and modern man. This is one of the most important features in which the Piltdown specimen differs from the apes. The height of the crown from the uppermost part of the root notch to the level of the base of the furrows between the cusps, is externally in each of the Piltdown molars 8.5 mm. This can readily be duplicated in man; but the available chimpanzees give only (2M): 5.5; 6.0; 6.5; 6.0; 6.5; 7.0; 6.5; 6.0; 6.0; 6.0; 6.5; 6.0 mm. The Piltdown, Mauer, Brelade (Jersey) and recent human teeth (in general) are high-crowned or hypsodont; the chimpanzees are as a rule low-crowned or chamaedont. A jaw with molars such as those of the Piltdown specimen cannot be that of a chimpanzee, unless we should arbitrarily assume some old form of that genus that was radically closer than recent chimpanzees are to the human type.

The height of the enamel on the crown is in general difficult to measure due to the irregularity of its lower limits. In the Piltdown teeth the condition is further aggravated by the wear of the teeth. Notwithstanding all this, it can be estimated that the enamel layer of the Piltdown molars averages externally very close to 6 mm. without the cusps and that with the latter it reached 7.5 mm. These dimensions are common in man, both old and recent; but they are never it seems equalled in the chimpanzees. Taking the total height of enamel on the external surface of the Piltdown molars, with the cusps restored, as 7.5 mm., the nearest approach in a chimpanzee (British and U. S. National

Museums) was 6.5 mm., and from this the measurements ranged to 5 mm., the most frequent figures obtained being 5.5 and 6 mm. Here then there is again an important difference.

The size of the individual molars in the Piltdown jaw is for M1, length along middle—13 mm., breadth max. at right angles to length 11 mm.; M2, length 13 mm., b. 11 mm.; length-breadth index of each 84.6. The worn surface of the crown of the second tooth appears to the eye a trifle larger than that of the first molar, but on measurement the teeth are found to be so closely alike that a distinction is difficult. The little difference that there is, is limited (as not seldom in other cases) to the trituration surface of the crown.

A good deal of weight has been placed upon the excess in the Piltdown teeth of their length over the breadth. It was apprehended as an inferior character and one placing the teeth nearer in type to those of the

LENGTH, BREADTH AND INDEX OF THE PILTDOWN AND OTHER MOLARS

	Side	Length in median line	Breadth max.	B-L Index	Length	Breadth	Index
		1M mm.	mm.		2M mm.	mm.	
PILTDOWN JAW.....	r.	13.-	11.-	84.6	13.-	11.-	84.6
Piltdown, extra tooth...	l.	13.-	11.-	84.6			
EARLY MAN: Mauer...	r.	11.5	11.5	100.-	11.5	11.5	100.-
Ehringsdorf.....	l.	12.-	11.-	91.7	12.5	11.-	88.-
MODERN MACRODONTs:							
226,107, New Britain...	l.	13.-	12.-	92.3	12.-	11.-	91.7
262,587 Arkansas.....	r.	12.-	11.5	95.8	11.5	10.5	91.3
304,095, Eskimo.....	l.	12.-	11.-	91.7	11.-	11.-	100.-
320,916-53, White U. S.	l.	11.5	10.-	87.-	11.-	10.-	90.9
CHIMPANZEES: <sup>6</sup>	Aver.	11.43	10.36	90.6	11.50	10.60	92.-
7 Males	r.	(10 to 12)	(9.5 to 11)	(87.- to 95.-)	(11 to 12.5)	(10 to 11)	(87.- to 95.5)
	Aver.	11.25	10.-	88.9	11.10	10.25	92.1
4 Females	r.	(11 to 11.5)	(9.5 to 10.5)	(86.4 to 95.5)	(10.5 to 12)	(9.5 to 11)	(87.5 to 100)

<sup>6</sup> Taking all the available specimens, hence also those in which one of the two anterior molars is missing, we find one sole tooth, the first right molar of male chimpanzee jaw #176,227, U. S. N. M., in which the index comes near being that of the Piltdown teeth; the dimensions of this molar are: L., 12.-; B., 10.-; Index, 83.3. Individual human molars of this form could doubtless also be discovered.



chimpanzee than to those of man. Upon closer examination into the subject this view is hardly sustained. On one hand we find individual human teeth both recent and ancient that closely approach the Piltdown molars; while on the other it is found that chimpanzee molars also, are in general relatively shorter.

Among the remains of early man the majority of the bones and teeth are, regrettably, so imperfect that exact measurements of the molars are impossible; but a remarkable resemblance to the Piltdown teeth is found in the molars of the recently discovered lower jaw of Ehringsdorf, Germany. The figures on page 345 show the measurements of the teeth in various specimens.

#### CONCLUSIONS

A detailed study of the Piltdown jaw shows this to be a truly remarkable specimen, and the more it is understood the more valuable it appears as a material proof of man's antiquity.

The jaw is more primitive than any other known jaw relating to early man. It still had a marked sub-mentoneal shelf, in all probability a large canine, and teeth of ancestral pre-human form. It resembles more or less in a number of points the jaws of the chimpanzee, but it differs from these in a whole series of points of importance, such as the form of the notch, type of coronoid process, subdued musculature, markedly reduced internal massiveness of body especially near symphysis; and in the most important characteristics of the teeth, namely, height of crown, height of enamel, nature of "cingulum" and stoutness of cusps—in all of which features it is nearer or like human.

It appears to the author that in view of all this it is no longer possible to regard the jaw as that of a chimpanzee or any other anthropoid ape; but that it is the jaw of either a human precursor or very early man. Dr. Smith Woodward's designation of this form as "*Eoanthropus*"—a being from the dawn of the human period—seems very appropriate.

#### THE SEPARATE MOLAR

The additional molar tooth of the Piltdown remains is in every respect so much like the first molar of the Piltdown jaw, that its procedure from the same jaw seems certain, and it would seem probable that the account of its having been discovered at a considerable distance away might be mistaken. The tooth agrees with those of the jaw perfectly not only in dimensions and every morphological character, but also in the degree

and kind of wear. A duplication of all this in two distinct individuals would be almost impossible.

#### THE CANINE

The canine tooth, which bears a close resemblance in form to the milk canine of the higher anthropoids, the author is inclined to regard, both on account of the shape of the crown as well as the shape and curvature of the root, as the right lower canine from a female jaw. The wear of the tooth is somewhat peculiar but not incompatible, it would seem, with this opinion. Taking into consideration the subdued muscularity of the Piltdown jaw, together with the strong indication of the presence of a large canine shown by the basal ridge on the anterior part of the outer surface of the body, it appears probable that the canine may after all have belonged to this specimen.

#### THE SKULL

A detailed new description of these fragments is not called for in this place, the more so as the writer has little to add to or alter on previous descriptions. An individual, or even genetic, specific, association of the Piltdown jaw with the massive remains of the two Piltdown skulls is, it may be repeated once more, exceedingly difficult of acceptance. The more the lower jaw is studied and understood the less in harmony it appears with the skulls and it is not unlikely that these latter belong to totally different, possibly chronologically younger, human individuals.





## THE SITTING HEIGHT

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### INTRODUCTION

The sitting height is important in the measurement of the living and it is easy to obtain. It represents the distance between the vertex of the cranium and the line connecting the tuberosities of the ischium, parts covered with a minimum of tissue even in the fat and muscular, and it is therefore exact. It also gives the length of both the torso and the legs.

The trochanter height and the pubic height, which have also been used considerably in anthropometry, are difficult to obtain with accuracy. Thick muscles and fascia and sometimes fat cover the trochanter, so that its upper border cannot be determined exactly, and the error in measuring from the ground especially when it is rough is apt to be great. The measurement of the pubic height is still more difficult to obtain because of the trouble to find the upper border of the pubis, or even the pubic spine, and because of the nature and sensitiveness of this region. The pubis may be high in some people and low in others depending upon the tilting of the pelvis backward or forward, the shape or posture of the vertebral column, the length or strength of the abdominal muscles, or from other causes. The position of the ischial

tuberosities is not affected by the tilting of the pelvis to the same extent as the pubis because the latter may be raised or lowered whereas the ischium would remain in almost the same horizontal plane. The posture may be controlled better when sitting than when standing, and this gives the advantage to the sitting height. The length and strength of the abdominal muscles admit of greater variation in the vertical position of the pubis than of the ischium. The height of the pubis does not give a good basis for the length of the torso or of the legs. For these and possibly other reasons the sitting height should be taken whenever either the length of the torso, or of the trunk, or of the legs, is desired.

The measurements can best be made with Hrdlička's instruments, methods, and *technique*. Care is necessary to be sure that the vertebral column is pressed firmly against the upright in the dorsal and sacral regions.

*Materials.* The materials for the present study include the measurements of the following persons:

1445 white children of Ann Arbor, Mich.	583 Negro soldiers of Camp Lee, Va.
776 Filipino children of Manila.	610 white soldiers of Camp Lee, Va.
377 male Filipino students, 18 years or over	523 white soldiers of Camp Gordon Ga.
183 Filipino men of Taytay	444 engineers, Motor Truck Camp Univ. of Va.
38 Indian-Filipino men of Cainta.	439 engineers, Motor Truck Camp and students, Univ. of Va.
63 Filipino women of Taytay.	50 Professors and students, Univ. of Va.
688 Negro soldiers of Camp Gordon, Ga.	

These 6,219 persons were measured by the author except 50 at the University and some at Camp Gordon. The literature has been searched for the past five years and records of nearly 250,000 others were obtained.

*Methods.* The present report is divided into three parts: I. The sitting height in children; II. The sitting height in the adult; and III. The distribution of the sitting height.

The age given is that of the nearest birthday.

The measurements were taken in a uniform manner, after instruction by Manouvrier and Hrdlička,<sup>1</sup> the person standing or seated on a plat-

<sup>1</sup> v. Hrdlička, A. Anthropometry. Phila. (Wistar Inst.), 1921.

form against a vertical scale, with a sliding square pressed down properly upon the head. Several direct readings were made of both stature and sitting height. The sitting height will be called the torso.

#### I. THE SITTING HEIGHT IN CHILDREN

The materials for this part are from children measured by the author in Ann Arbor, Michigan, in 1906-7 and in Manila, P. I. in 1907-8.

The children of Ann Arbor were partly British American, whose parents were from Canada and the United States, partly German American, one or both parents being of German extraction.

The children of Manila were attending the Trade and Normal schools from all parts of the Philippines, except the young children who were from Manila and vicinity. They represent the more stable and progressive elements in the Philippines, many of whom are Chinese and Spanish Mestizos. They show a preponderance of yellow-brown blood, with traces of Negrito.

A word about the Filipinos may not here be amiss. The Filipino is essentially a Malay, and the Malay is largely a mixture of the southern Asiatic with the Negrito. The southern Asiatic is in turn a mixture of the White (Mediterranean and Indo-European), Yellow-Brown (Mongolian) and Black (Negrito), three fundamental world stocks. The Malay was formed by a continually recurrent fusion of the southern Asiatic with the Negrito who inhabited southern Asia and the adjacent islands. Wave after wave of these people passed out into the Pacific and each was of a slightly different composition. Thus each locality in the Philippines and the islands adjacent thereto is slightly different from the other in the characteristics of the people. There still remain pure Negritos in the Mariveles Mountains and along the east coast of Luzon. Recent Mohammedan (Arabian) movements spread over the Philippines during the 200 years before the Spanish came, and there has been considerable fusion of the Spanish and other European nationalities with the Filipinos during the past 300 years. East Indians have come into the Philippines directly from time to time, and there has been an infiltration of the Chinese for possibly a thousand years. The small trade of the islands is largely in the hands of the Chinese and their Mestizo descendants, who are among the best families in the littoral region of the archipelago.

The majority of the students of the Trade and Normal Schools in the Philippines are from the littoral population of the archipelago, although some come from the inland tribes, some are mixed Negritos



and a few are pure Europeans. It would have been futile to attempt to segregate the component elements among the students because color and other characteristics obscure conditions; therefore all the records are included. Notes however were made at the time the records were taken as to whether European, Mongolian or Negro characteristics predominated in each individual, and these will be utilized. The following table gives the number of persons at each age measured by the author.

TABLE I. THE NUMBER OF PERSONS AT EACH AGE.

Age	Boys			Girls		
	British American	German American	Filipino	British American	German American	Filipino
5	5					
6	20	22		21	16	
7	44	30	27	33	28	5
8	32	33		46	28	
9	31	36		42	31	
10	44	44		43	36	
11	49	45	34	36	43	14
12	57	33		49	43	
13	31	33	18	44	33	6
14	37	31	20	49	11	12
15	33	12	43	27	13	15
16	22	3	65	17	8	19
17	8		105			27
18			124			
19			78			29
20			54			
20+			63			18

## THE GROWTH OF THE TORSO

The principal results of the study as to the growth of the torso will best be seen in the accompanying chart. Some of the important facts to be noted are that the torso is longer at each age in the British Americans than in the Filipinos, while the German Americans are in between, in both boys and girls; the torso of the girls is longer than that of the boys up to the age of 16 years, except for a short period between 7 and 10 when the torso of the boys is longer; the torso of the Filipino girls is longer than that of the boys up to 11 years, after which there is some irregularity up to the age of 15 when the torso of the boys becomes decidedly longer than that of the girls and so remains; the most rapid growth of the torso is usually from 10 to 12 years in girls and from 11 to

15 in boys, but in the Filipinos this is from 13 to 15 in girls and from 13 to 17 in boys; this increase in the rate of growth is delayed in German

*The actual growth of the torso (Personal measurements).*

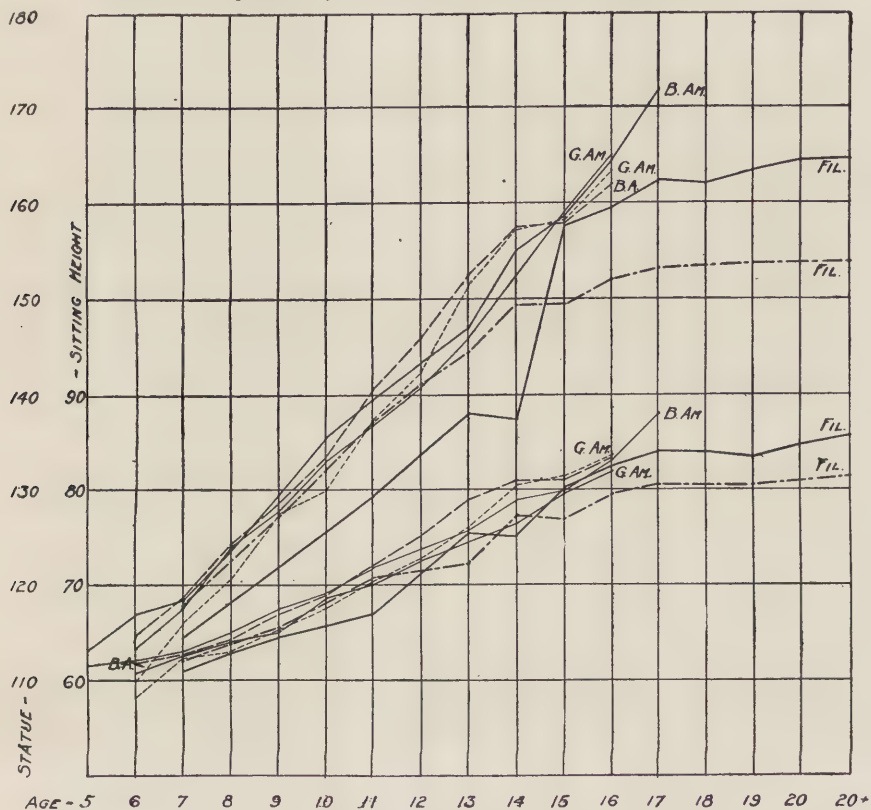


CHART I. The solid lines represent males, the broken lines females. B. Am. is British American, G. Am. is German American, Fil. is Filipino. From measurements made by the author.

American children as compared to English American; in the Filipinos it is delayed more than in either and occurs two years later than in British American children; and in general the rate of growth in stature increases in girls to about the age of 11 years and in boys to about the age of 16, after which it decreases.

It may be of some interest to note that at the period of least variability in stature and torso the death rate in children in general is least. What relation there is between the two phenomena, if any, remains to be determined.

In other racial groups the growth of the torso appears as follows:

*The actual growth of the torso. (Other groups).*

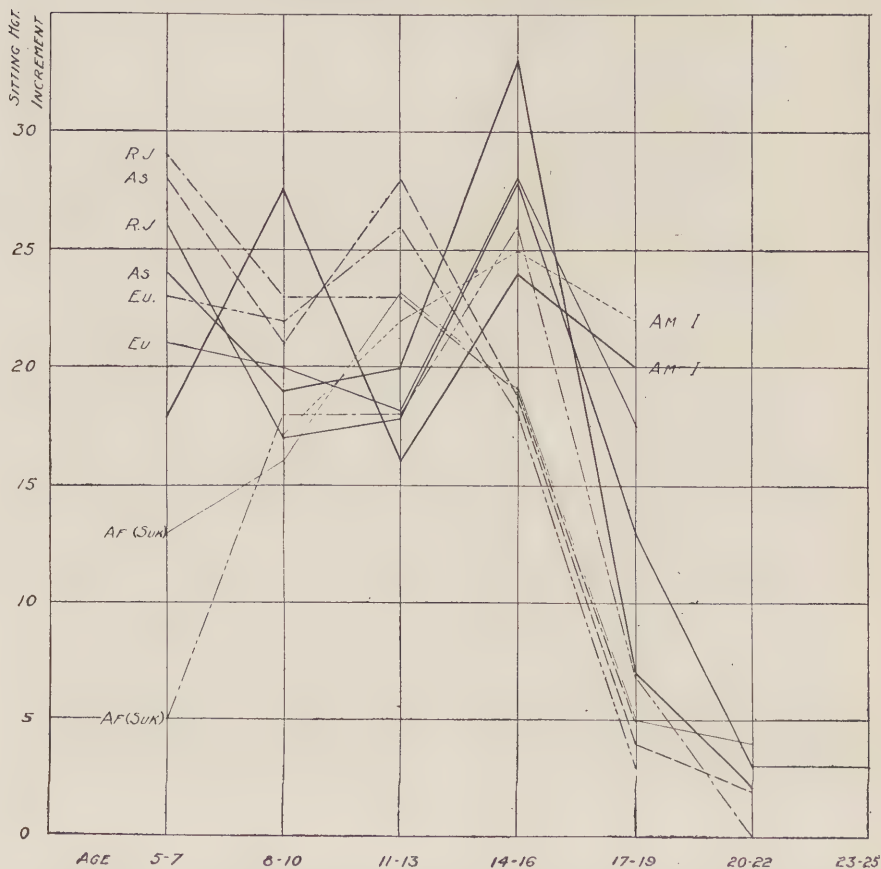


CHART II. The solid lines represent males, the broken lines females. Af. (Suk) are records of the Bantu Zulus of south Africa kindly furnished by Dr. Suk of Bohemia. As. are records of Chinese by Bobbitt and Pyle and Filipinos by Bobbitt and Bean. Eu. are records of Germans by Ranke, and American whites by Hrdlička, Hastings Smedley and Bean.

Am. I. are records of American Indians at approximate ages by Hrdlička.

R. J. are records of Russian Jews by Weissenberg.

The average yearly increment in growth of the torso from 5 to 22 years, for males, is 1.82 cm. in Asiatics, 1.54 in Europeans, 1.35 in Africans; and for females it is 1.45 for Asiatics, 1.34 for Europeans, and 1.23 for Africans. The growth of the torso is greater in the Chinese and



Filipinos than in the other groups, and is the least in the Negroes, with the Europeans between. The exception to this is that the growth in the American Negro girls (mostly of mixed blood, negro-white) is equal to that of the other girls. The Russian Jews appear to be the most precocious in the growth of the torso among the European groups, the Germans seem the most retarded, and the English Americans are in between. The causes of these differences need determination.

According to the data the torso seems to have two periods of rapid growth, the first from 5 to 7 years in boys and girls alike, the second from 11 to 13 years in girls and 14 to 16 in boys. In the Filipinos and Chinese there seems to be a third period after the age of 20 years, but this needs confirmation. The torso of Asiatic boys and girls grows however more in the second period than that of any of the other groups. In American Negroes the most rapid growth period comes later than in other groups, and the growth of the torso is less. The first period of rapid growth in American Negro and also American Indian boys comes from 8 to 10 years instead of from 5 to 7 as usual.

The torso of the girls grows 5 per cent more than that of the boys between the ages of 5 and 16 years, but the torso of the boys grows more after this.

#### THE SITTING HEIGHT INDEX

The sitting height index is the sitting height or torso in terms of the stature taken as 100. It serves well as an indicator of growth relationships, because when it reaches its lowest mark it represents the time at which the rapid growth of the lower extremities decreases and the rapid growth of the torso increases.

The lower extremities are seen to grow more rapidly than the torso up to the following ages: British American girls 11 years; German American girls 13 years; Filipino girls 13 years; British American boys 15 years; German American boys 16 years; Filipino boys 14 years.

After the ages given above the torso grows more rapidly than the lower extremities. The age at which this change takes place is earlier in girls than in boys; it is earlier in the Filipinos than in the British Americans, and earlier in the latter than in the German Americans.

We have already seen that the most rapid growth of the torso occurs later in the Filipinos than in the American whites. We now see that the growth of the torso is relatively greater than the lower extremities at an earlier age in the Filipinos than in the American whites. This means that the growth of the lower extremities slows down earlier in the

Filipinos than in the American whites. We recorded in a previous paper on stature and the teeth (*Am. J. Anat.*, 1914), that the Filipinos are precocious in the periods of acceleration in stature compared to American whites, and we see from chart I that their definitive stature is

*The Sitting Height Index (Personal Measurements).*

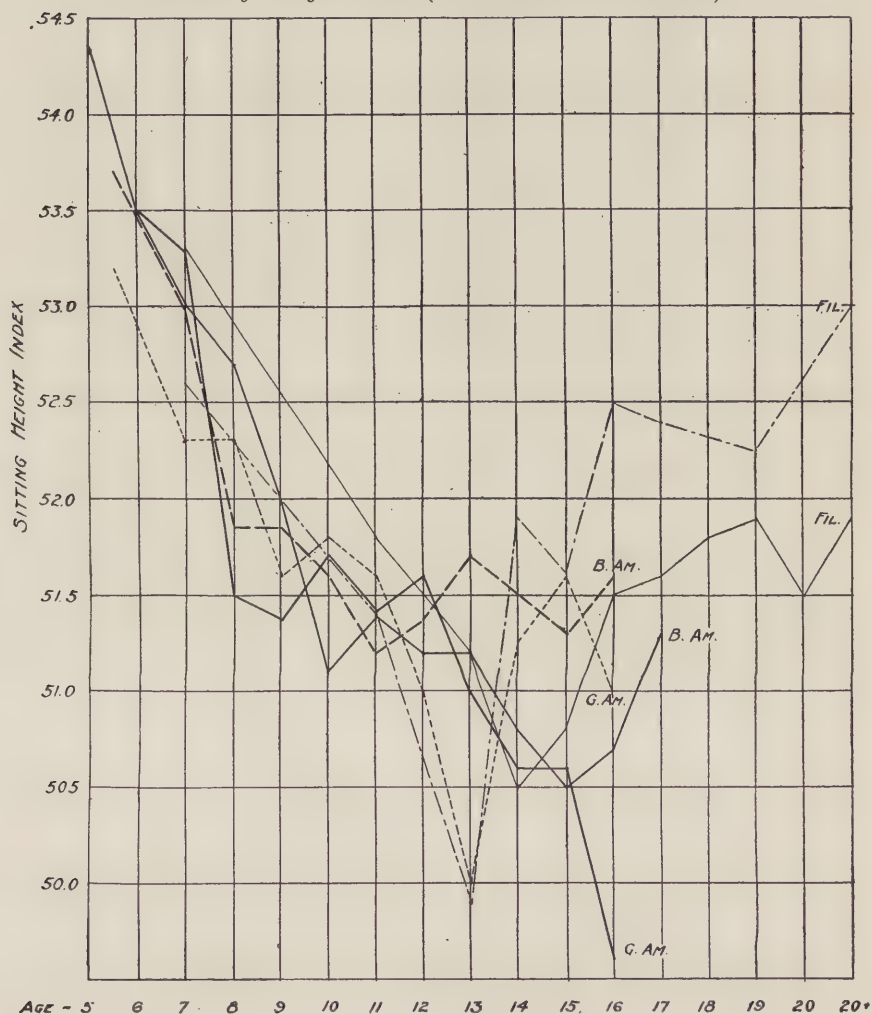


CHART III. The solid lines represent males, the broken lines females. B. Am. are records of British American children, Fil. of Filipino children, and G. Am. of German American children, measured by the author.

reached at an earlier age than is that of American whites. We also note from charts II and III that the Filipinos and other Asiatics have a more rapid growth of the torso during the periods of its rapid growth than is found in other groups. We may infer from the above that the Asiatics are precocious in the growth of the lower extremities which produces a precocity in stature, because after birth the stature follows the length of the lower extremities more than it does that of the torso as the result of the greater growth of the former than of the latter. There is an apparent precocity of the torso growth as represented by the sitting height index in Asiatics, because of the lag in the growth of the lower extremities at an early period. The early cessation in growth of the lower extremities and the more rapid growth of the torso during the periods of rapid growth produce the condition of long torso and short extremities found so frequently in the Filipinos and other Asiatics. The torso not only grows faster at the periods of most rapid growth but the rapid growth periods extend to a later age in Asiatics than in Europeans.

The Filipino girls have a relatively longer torso before the age of 12 years than the Filipino boys, and their stature is also greater, which is not true of American children, except at the ages of 11 and 12 in the British Americans. After this age the condition is reversed, the Filipino boys have a relatively longer torso than the Filipino girls, whereas the American girls have a longer torso than the boys, although after the age of 14 years the stature of the boys is greater than that of the girls. This indicates a precocity on the part of the Filipino girls that exceeds that of other groups.

Filipino boys have a greater stature and torso length at 13 years than is found in American boys, and the sitting height index reaches its low point and begins to rise earlier in the Filipino than in the British American boys. This is evidence of precocity in the Filipinos. Metamorphosis is earlier as proved by the early cessation of rapid growth in the lower extremities, and the early rapid growth of the torso, as well as the early definitive stature. The Filipino has a later rapid growth of the torso than the American white, and in the Filipino the sitting height index increases more than in the American white after 16 years of age, hence metamorphosis continues later in the Filipino than in the American white. The adult sitting height index of the Filipino is the same as that of the European or American white as we shall see later. This may be the result of the mixture of the Mongolian and Negrito as well as the European in the Filipino: the Negrito with a low sitting height



index, long duration of the growth of the extremities and short duration of the growth of the torso, the Mongolian with the reverse, and the white in between. The Filipino is nevertheless more like the Mongolian than like the Negrito.

*The Sitting Height Index in other Groups.*

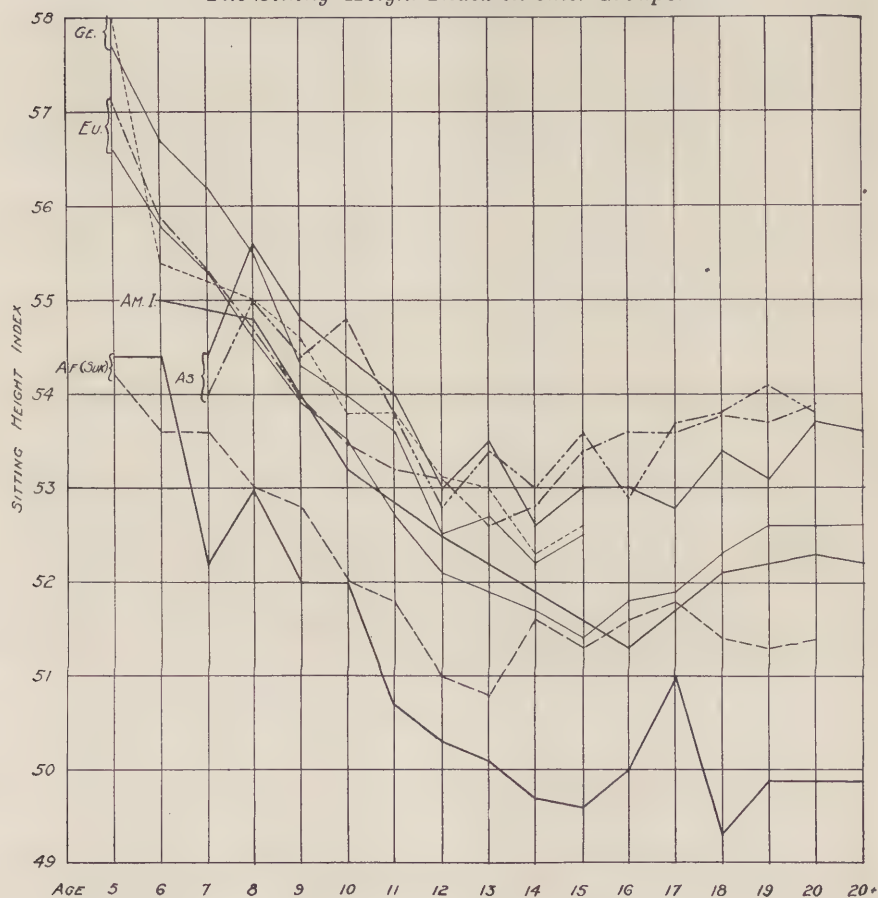


CHART IV. The solid lines are males, the broken lines females.

Af. (Suk) are records of the Bantu-Zulus of south Africa kindly furnished by Dr. Suk of Bohemia.

Am. I. are records of American Indians by Hrdlička.

As. are records of Chinese by Bobbitt and Pylé and Filipinos by Bobbitt and Bean.

Eu. are records of American whites by Hrdlička, Hastings, and Smedley.

Ge. are records of Germans by Ranke.

From Chart IV it may be seen that the time at which the rapidity of growth of the lower extremities begins to decrease and the rapidity of growth of the torso begins to increase varies with different ethnic groups. The list below will illustrate this:

		GIRLS	BOYS
Chinese	(Pyle)	12	14
Chinese	(Bobbitt)	14	14
Filipinos	(Bobbitt)	12	14
Filipinos	(Bean)	13	14
Asylum whites, New York	(Hrdlička)	13	14
School whites	(Smedley, Hastings)	13	15
British Americans	(Bean)	11?	15
Russian Jews	(Weissenberg)	13	15
German Americans	(Bean)	13	16
Germans	(Ranke)	14	14
Asylum Negroes, New York	(Hrdlička)	14	15
School Negroes, Washington, D. C.	(MacDonald)	14	16
Bantus	(Suk)	13	15
Sioux	(Sullivan)	11	16

The girls are more precocious than the boys and the difference is about two years, with the respective ages about 13 and 15 years. In general the Asiatic is in this respect precocious, the African retarded, the European in between.

The average yearly growth of the torso is 2.11 cm. for the female African between 11 and 13 years, 2.57 for the European, and 2.75 for the Asiatic; it is 2.23 cm. for the African male between 14 and 16 years of age, 2.81 for the European, and 3.27 for the Asiatic.

The Negro children in Washington, D. C., have shown an average growth of the torso of more than 2 cm. per year for but six years whereas the white children have the same amount of growth for nine years. The Negro children of Natal and Zululand (Suk's data) have less average yearly growth of the torso than the largely mixed Negro children of Washington.

The torso of the Asiatic begins to grow more rapidly than the lower extremities about a year earlier than in the European, it continues to grow for a longer period of time, grows more after 20 years, grows more rapidly, and is relatively longer in the adult than that of the European except where the Mediterranean or Negrito element predominates, as in India. In a paper written by the author in 1909 ("Filipino Types") the following suggestion was made: "The Filipinos may have an early

rapid development which is from the European standpoint premature, and a late maturity which is incomplete, at least it looks as if the growth is continued up to a later age in the Filipinos than in the Europeans, but the extent of development is less." The present study seems to confirm that suggestion.

The torso of the American Negro begins to grow more rapidly than the lower extremities at a later date than for the European, and the time of rapid growth is less for the Negro. This is also true of the African Negro. This, in connection with the short torso and long lower extremities in the adult Negro, suggests that the Negro has a long youth and a short adolescence, as suggested by Bardeen.

Bardeen (1920) believes that the Asiatic has a short youth and a long adolescence and the African a long youth and a short adolescence, whereas the European is in between. The result is that the extremities of the Asiatic are predominately relatively short and the torso long, the extremities of the African are long and the torso short, and the European is between. The sitting height index as herein ascertained corroborates this, although the results here may not be conclusive. There is evidence from this study that in general the Chinese and Filipinos conform to the suggested Asiatic type, the American Negro conforms to the suggested African type, and the American white conforms to the suggested European type.

More data are needed at all ages for the Asiatic and the African, and for the late period of growth after the age of 16 years in the European. There are many groups among the peoples of different countries, and variations in growth will no doubt be characteristic of the groups. Even among the Negritos of the Philippines there is more than one anatomical type and this is also true of the Pigmies of Africa. There are nevertheless fundamental tendencies for each of the three continental peoples, the Asiatic, European and African. Derivatives from these three stocks would have the same tendencies. When the three are combined as in the Filipinos all three tendencies may be manifest.

#### OLD AGE AND EMBRYO

Stature decreases with advancing age in the adult especially after the age of 60 years, and the torso decreases in length more than the extremities, which results in a lowering of the sitting height index. Whether this is due to "a loss in elasticity in the intervertebral discs," as stated by Bardeen, remains to be seen. There is a shrinkage in all the soft tissues, and this is shared by the discs, but the muscles shrink



considerably more. The shrinkage of the sacro-spinalis musculature would increase the lumbar curve, and the shrinkage of the dorsal neck muscles would increase the cervical curve of the vertebral column, which would then resemble that of the Negro. The sitting height index in the aged approaches that of the Negro. Pfitzner gives the sitting height index of 303 men from 40 to 60 years of age as 52.7, of 130 men from 60 to 70 years as 51.9, of 100 men from 70 to 80 as 52.0, and of 27 men from 80 to 90 as 51.6. The condition in the aged is probably the result of several factors, the stoop of age, the shrinkage of the muscles, the shrinkage of the intervertebral discs, and also a slight shrinkage of the long bones. The shrinkage is therefore greater in the torso than in the extremities. Persons beyond the age of 60 years should not be included as normal adults.

TABLE II. SITTING HEIGHT BY STATURE IN THE ADULT. PFITZNER.

Stature	141-150	151-160	161-170	171-180	181-190
Male	53.1	52.6	52.4	52.1	51.8
No.	34	277	748	295	9
Female	53.0	52.9	52.6		
No.	223	612	197	3	

TABLE III. SITTING HEIGHT AND STATURE BY AGE IN THE ADULT. PFITZNER.

Age	41-50	51-60	61-70	71-80	81-90
Male					
Number	133	173	130	100	27
Stature	166.2	165.3	165.4	163.6	162.2
Index	52.7	52.7	51.9	52.0	51.6
Female					
Number	92	103	97	105	33
Stature	155.5	155.1	154.2	152.6	151.1
Index	53.1	53.0	52.5	52.1	53.1

Streeter in an article entitled "Weight, sitting height, head size, foot length and menstrual age of the human embryo" (*Carneg. Inst., Pub.* 274, 1920), shows in table 1 that the sitting height grows more rapidly from the 12th to the 18th week of intrauterine life than before or after,

and there is a slight retardation in growth between the 28th and 36th week. This wavelike growth is found after birth as already pointed out, the periods of rapid growth being about the seventh and eleventh years, at times when the permanent teeth are erupting most rapidly and the long bones of the extremities are growing more slowly. This illustrates the law of alternation in development as already stated by me in a paper on the teeth. (*Am. J. Anat.*, 1914).

## II. THE ADULT SITTING HEIGHT

The average sitting height index for each group measured will next be given. The term *index* will be used to mean the sitting height index, unless otherwise specified.

TABLE IV. THE AVERAGE RELATIVE SITTING HEIGHT IN THE ADULT.

Group	No.	Race	Stature	Index	Sit. ht.
Manila students	377	Mestizo-Malay	163.3	52.5	85.6
Taytay men	183	Malay	159.5	52.6	84.0
Cainta men	38	Malay-Indian	160.9	52.2	83.8
Taytay women	63	Malay	147.8	53.1	78.4
Camp Gordon	688	Negro-American	172.9	50.5	87.3
Camp Lee	583	Negro-American	169.7	51.0	86.6
Camp Lee	610	White	172.4	52.7	90.6
Camp Gordon	523	White	174.8	52.3	91.2
Motor Truck Camp	444	White	174.1	52.3	91.0
Students, soldiers and instructors	489	White	173.8	52.0	90.4

*Race.* The Negro records are placed between those of the Filipinos and the American whites to show readily the differences. Pfitzner has demonstrated that the leg length varies directly with stature, therefore the index varies inversely with stature; in the tall the legs are relatively long and the torso relatively short, and in the small the reverse. This is true only within the race (see tables 5 and 6). The American whites and the Filipinos have the same sitting height index although the American whites are 10 centimeters taller than the Filipinos, and the Negroes have a smaller index than the American whites although not so tall.

The small index in the Negro is the result in part at least of the short, sinuous trunk of the Negro. The Negro trunk has marked convexities forward in the lumbar and cervical regions and backward in the thoracic and sacral regions. This was observed by me for several years in the dissecting room, and at Camps Lee and Gordon many Negroes showed this condition on inspection. It is more pronounced in the

true Negro than in the frequent mixed American Negro. When the sitting height of the Negro was taken the vertebral column would not touch the wall in the cervical and lumbar regions, the back could not be straightened, the thorax and buttocks projected backward and the head and abdomen forward. The head can be brought into line with the thorax and buttocks behind only by elevating the chin. The legs of the Negro are thrown back at the hips, the pelvis is tilted forward to bring the body to the center of gravity, the spinalis musculature is contracted to pull back the trunk and thus maintain the erect posture. The lumbar curve is thereby increased. The abdominal muscles pull the upper ribs and sternum forward and downward because of their tension as a result of the tilting of the pelvis, the protrusion of the lumbar vertebrae into the abdomen, and the action of the spinalis musculature, thereby increasing the dorsal convexity. The result is a shortened torso and relatively long legs. This may also help to explain the backward protrusion of the buttocks and thorax, and the forward protrusion of the head and abdomen in the Negro, which gives them the appearance of having a rugged muscular torso. The short trunk may be caused partly by mechanical factors, though malnutrition may play a part, but the posture, relaxation, burden bearing, flat foot, and muscular pull also contribute, although the primary cause of the increased curvatures of the Negro spine is the effort to maintain the erect posture.

*Stature.* The stature of the American white soldiers and the Negro soldiers at Camp Gordon was higher than at Camp Lee and the index was lower, and the stature of the Manila students was greater than that of the men of Taytay and the index was lower; but on the contrary, the Cainta men of less stature than the Manila students also have a lower index, and the students of the University of Virginia have a lower stature and a lower index than the white soldiers of Camps Lee and Gordon. Differences in the proportions of the anatomical types in the different groups explain the differences in index. For instance there are more hyper-ontomorphs<sup>1</sup> among the men of Cainta than among the men of Taytay and there are more hyper-ontomorphs among the students than among the white soldiers. The hyper-ontomorphs have a low index and this makes the index of the Cainta men and the students low.

*Sex.* The women of Taytay have the lowest stature, but the index is the same as that of the Virginia University Professors who have almost

<sup>1</sup> For explanation of these terms see author's other publications.



the highest stature. The women have a larger proportion of the hypo-ontomorph type among them than the men, and this would account for some difference, but there is also a sexual difference: the women have in general relatively longer trunks than men. The Negrito blood of the Taytay women would give a low index, and the Chinese blood would give a high index, but the low stature, the hypo-ontomorph type and the sex would combine to make the index high.

#### SUMMARY

The sitting height index is shown to vary with race, type, stature and sex.

The index is the same in the American white and the Filipino, but less in the Negro. The trunk of the Negro is greatly curved thus making it both absolutely and relatively short, which with relatively long legs accounts for the low index in this race.

The index decreases with increase in stature. The American white is taller than the Filipino and therefore should have a smaller index, but the Filipino has a considerable amount of Negrito blood, and a large amount of the hypo-ontomorph type, which reduce his index to the level of that of the white American.

The index is greater in the female than in the male. The number of hypo-ontomorphs was 50 per cent greater among the females than among the males under observation, and the stature of the females was less than that of the males. The sex difference is a result of type, stature and sex.

Finally, the sitting height, and therefore the leg length, are dependent not only on growth but also on metamorphosis.

### III. THE DISTRIBUTION OF THE SITTING HEIGHT

The materials for part III include the records of many authors, with measurements of more than 200,000 persons, in about 400 groups, of peoples throughout the world.

*The three great masses of peoples.* In any study of the peoples of the earth it may be well to bear in mind that the three great masses, African, Asiatic-American, and European, represent the fundamental stocks that carry on evolution. Other peoples about the fringes of these great masses, or in isolated regions, such as the Eskimo, Australians, Melanesians, Negritos, and others represent modified peoples through isolation and selection, or mixtures, blends, or mosaics who have undergone various changes.

The average stature, sitting height and sitting height index for the great continental masses of peoples are given in table 5.

TABLE V. THE AVERAGE STATURE AND SITTING HEIGHT INDEX FOR THE FOUR GREAT MASSES OF MEN.

Mass	Stature	Sitting height	Sitting height Index	Number
Male				
Asia	165.0	88.0	53.5	1,267
America (Indian)	168.0	88.0	52.3	1,050
Africa	172.0	85.0	49.5	3,500
Europe	165.0	87.0	52.5	165,000
Female				
America (Indian)	157.0	82.0	52.6	500
Africa	162.0	80.0	49.4	100
Europe	155.0	83.0	53.5	1,500

An effort is made to leave out the peoples along the fringes and to take only records from centrally located groups. This is easy to do for a large part of Asia and means more than for the other continents, because the Chinese are centrally located and have been fairly stable in their territory. America is somewhat like Asia, although movements have been common and the American Indians are comparatively recent entrants. They have however become isolated and are therefore best given apart. Africa, in the north, is a continent of recurring movements of peoples largely from Europe and Asia. The heart of the continent has not been explored nor have the natives of the interior been measured, to a sufficient extent, therefore most of the available records will be those of Negroes mixed more or less with whites. Europe has had interminable intermingling of peoples, but they have been mostly of the same or similar stocks.

From table 5 it will be seen that Asia and Europe have on the whole the same stature, while that of America is higher, and that of Africa still higher. The Negroes measured were chiefly impure stocks such as the Nilotic, Nigerian, Bantu and American. America and Asia have the same sitting height, that of Europe is less and that of Africa is still less. Asia has the highest sitting height index, that of Europe is next, that of the American Indian is close to that of Europe, but that of the Negro is far lower than the others.

*Outlying groups of peoples.* When we examine the sitting height index for outlying groups as illustrated in table 6, we find the lowest index among the Australians and the highest among the Eskimo. Closely related to the Australians are the Negroes, Negritos, and Melanesians, while closely related to the Eskimo are the Siberians, Chinese, and Aino. A low index relates to the Negroes and a high index relates to peoples of low stature who live under adverse conditions.

TABLE VI. THE SITTING HEIGHT INDEX OF SELECTED GROUPS.

GROUP	MALE		FEMALE	
	No.	Index	No.	Index
Africa .....	3,884	49.9	185	50.3
Europe .....	8,499	52.4	1,346	53.1
Asia (Chinese) .....	1,429	53.6	25	53.0
Other Asiatics .....	158	52.4	46	52.4
South America (Indian) ..	2,812	52.4	756	53.2
North America (Indian) ..	1,398	52.0	494	52.1
Eskimo .....	94	53.7	74	54.6
Siberians .....	1,417	53.5	72	53.5
Aino .....	90	52.8	71	53.6
Malay .....	1,417	52.1	125	52.0
India .....	598	51.6	...	...
African Pigmies .....	49	53.7	16	52.9
Negritos .....	378	50.9	10	49.8
Melanesians .....	200	50.0	10	51.3
Central Africans .....	226	47.4	...	...
Australians .....	40	45.5	10	47.9

When we combine the groups in table 6 with those in table 8 it will be noted that the sitting height index of the Negroes of central Africa is 47.4 and that of the Australians is 45.5. This index changes gradually through the Melanesians, 50.0, and Negritos, 50.9, to the East Indians, 51.6, and Malays, 52.1. In each group the Negro influence is distinct and in diminishing amount. The index of the Eskimo is 53.7, and the index drops gradually through the Siberians, (male 53.5, female 53.5), to the Chinese, (male 53.6, female 53.0). The African Pigmies, (male 53.7, female 52.9), and the Aino, (male 52.8, female 53.6), are similar to the Eskimo in the index, and represent isolated fragments of the Negro and mixed stocks in the same way that the Eskimo represent isolated fragment of the Asiatic stocks.

The tropical forest people, especially the Pigmies of Africa and the Indians of the Amazon basin, have not only the handicaps of luxuriant



vegetation which prevents agriculture, few domestic animals, tough grass, insect pests, rusts, blights, and bacterial infections, but to these must be added the natural aversion to labor and lack of energy on account of the disadvantages of the tropical climate. The frozen desert people of the north such as the Eskimo, Northern Siberians and Lapps, labor under disadvantages of slight rainfall, scanty vegetation, practically no agriculture, few animals and a sparse population. The result in either case is a stunted body growth, which through heredity has become more or less fixed. Dr. Donaldson suggests that the large torso and short extremities allow a relatively larger set of vital organs that make the people more vigorous, hardy, and resistant to adverse conditions. The extreme forms of this type are found in tropical forest and cold desert, but other peoples adjacent to them are similar in type and among all peoples sporadic cases occur, and variants that approach that type. On the other hand are people who are the direct reverse, and between the two may be found endless intergrades.

A few notes about the Pigmies may not be out of place here. Poutrin describes two or more types of Pigmies in Africa. The Ba-Binga, or true Pigmy, is small, 150 centimeters in stature, muscular, with long torso, high large pelvis, short legs, long arms, low cranium, large nose (straight and wide), feeble prognathism, and projecting chin. The Ba-Tua is a Negro model reduced, with all the Negro characteristics except size: small, 150 centimeters and over in stature, thin, with short torso, long legs, small, low pelvis, high cranium, low, broad, depressed nose, considerable prognathism and reduced chin. The sitting height index of the males and females of the two classes are given in table 7.

TABLE VII. THE STATURE AND SITTING HEIGHT INDEX OF AFRICAN PIGMIES, BA-BINGA, POUTRIN.

Group	No.	MALE		No.	FEMALE	
		Stature	Index		Stature	Index
Labaye	9	148.6	54.3	7	143.5	53.1
N'Gali	8	148.0	55.5	5	144.3	53.3
Ouessou	4	151.2	53.3			
N'Gongo	4	154.0	52.0			
M'Bio	12	155.1	53.2	4	154.7	51.5
Gondicola	12	158.4	52.8			

As the sitting height index decreases and the stature increases, the form becomes more like the true Negro. The pure Ba-Tua are in this respect intermediate between the Ba-Binga and the Negroes. This

refers to the "type sousdolichocéphalique" of Poutrin. The "type brachycéphalique" has a stature of approximately 143 centimeters for the male and 137 for the female. This is then a third type, probably more infantile than the Ba-Binga, certainly smaller. The "type sousdolichocéphalique" and the Semang have the same stature and the same sitting height index; they are identical in this respect with the Kubus of Sumatra, and not materially different from the Aino. This seems to mean that under adverse environment various peoples may become altered in the same way, becoming more infantile or hypo-ontomorph in type. The Aino represent probably a mixed group, the Pigmy represents the Negro, the Eskimo represents the northernmost Asiatics, and the Malay represents the much more southern Asiatic, all of the hypo-ontomorph type.

Dr. Hrdlička kindly furnished me with records of the stature and sitting height of 231 adult male and 120 adult female Negritos of the Philippines measured under his direction by Dr. Philip Newton. The stature of the males is 146.8 cm. and the index is 50.6, and the stature of the females is 138.8 cm. and the index is 51.2. They are distinctly of the African *Negro* type. This verifies my own observations of certain Negritos in the Philippines. Other types of Negritos there are of the African *Pigmy* type. The Senoi or Sakai seem to be mixtures of the Semang and the Malay because the index is the same as the European, identical with the mixed Filipino, and the explanation is that the low index of the Negrito and the high index of the Mongolian neutralize each other and leave the index in between, like that of the European. People who resemble the Senoi or Sakai may be found in all the large islands of the Philippines, especially toward the interior where the Negritos formerly existed.

The sitting height index is shown by Martin to vary in all countries and he gives the lowest index of the male Europeans as 51.4 for the Ukranian Jews, the highest as 53.7 for Esthonians; of the females 53.2 for the Great Russians and 53.7 for the Russian Jews; the lowest index of the male Asiatic as 50.8 for the Malai, the highest as 54.8 for the Aino; of the females as 51.7 for Cambodgia and 54.6 for the Aino; the lowest index of the male African as 48.9 for the Masai, the highest as 54.0 for the Pigmy; of the females as 50.5 for the Bushmen and 53.2 for the Pigmy; the lowest index of the male American natives as 50.6 for the Trumai Indians, the highest as 53.5 for the Eskimo; of the females as 51.1 for the Trumai and 53.7 for the Eskimo. These records of Martin, like those from Giuffrida-Ruggeri, are given without stature and therefore were not used in the tables and charts.

Giuffrida-Ruggeri gives 30 groups of East Indians of about 100 in each group, from Burma and Bombay which show indices varying from 49.6 to 52.5, suggesting the influence of a Negro stock. The peoples of India are derived from four chief sources, first the Negritos, second Asiatics from the north, third the Mediterraneans, and last the Aryans or Indo-Europeans from northern Europe. There seems to be more Mediterranean stock in the Deccan, and especially among the Todas and Tamils. Twenty groups from the Balkans given by Giuffrida-Ruggeri, with from 12 to 2,341 individuals in each group, give indices varying from 51.8 to 52.6. The low sitting height index goes with the Mediterranean stock and the high index with the Slav. The index of the Spanish is 52.1 and of the Swedes is 52.9, which would indicate the difference we would expect between a small and tall group except that the index is reversed. This emphasizes the difference in type. The Spanish are of the Mediterranean stock and the Swedes of the Nordic, and the inference is that the Nordic is more like the Slav than like the Mediterranean. Six groups from north Nyassa have indices from 49.8 to 51.5, Algerians have an index of 51.7 and Kabyles of 52.8. Here we have the Mediterranean race mixing with the Negro, and in the Kabyles there may be Nordic elements.

Topinard gives six groups of Western European males with indices varying from 52.2 to 52.8, and six other groups from other parts of Europe with indices varying from 51.4 to 54.9. He also gives the index of Australian males as 50.8.

Baxter and Gould give the perineum-to-sole length of 12,640 white soldiers as 47.5 per cent of the stature which would give an approximate sitting height index of 52.5. In 2,020 Negroes this was near 51.5 and in 517 Iroquois, mostly mixed bloods, it was near 53.4 per cent.

*Summary of the sitting height in large groups.* We may now turn to a more detailed consideration of the sitting height and then give the summary as found in the chief groups of living men. The details may be found in Table 8 arranged in groups by stature. In each stature-group the index is arranged serially, the lowest first and the highest last. More Negro or negroid groups are given in the table than European, Asiatic and all other groups, therefore the records are not fairly representative. The negroid peoples have a low sitting height index, therefore their records will fall near the first of each stature group, and the Asiatic, American Indian and European will be found in the second half. The Pigmyes, Siberians, Aino and other peoples of stunted growth have the highest indices in the low stature groups, and the Europeans and American Indians have the highest indices in the high stature groups.



The records from table 8 (see end of article) are utilized for the great continental masses of peoples, each of which below will be presented separately, beginning with Europe.

#### EUROPE (AND AMERICA)

The median index of the male is 52.3, the lowest is 51.4 in Little Russians and Livonians, and the highest 53.7 in Esthonians. The majority of the groups of the European males are found between 160 and 180 cm. in stature, and of the females between 150 and 160 cm. The 119,571 Spaniards and the 44,929 Swedes (Giuffrida-Ruggeri) have respective indices of 52.1 and 52.9, which would indicate that the body type of the two is somewhat different.

#### AFRICA

The median index of the male is 50.0, the lowest is 47.4 in Central Africa, and the highest is 55.5 in the Pigmy. The extremes are much further apart than for any other great mass of peoples (unless we include the Pacific Islanders as a great mass), as a result not only of diversity of environment, but also owing to differences of type and variety of mixture. The highest index is found in the Pigmies, and the lowest in Central Africa as already noted, but the tall negroes who surround the central part of the continent of Africa, and especially the Nigerians, Soudanese, Nilotic and Bantu-Kaffir-Zulu Negroes have a low index although they show varying amounts and kinds of mixture with foreign stocks, chiefly European. These Negroes are found in the stature group 180 to 190 cm. and a part at least of their small index is the result of the tall stature. The true Negro of Central Africa is not tall, but has relatively long extremities and a short torso, and some of these characteristics are retained in the tall Negro. The Pigmy, by contrast with the tall Negro and the true Negro has a stunted growth with retention of the infantile characters, the extreme form of the hypo-ontomorph, therefore the index is high.

Had more true Negroes been included in the records and fewer of the Pigmies and tall Negroes, the stature groups would have been less extended and more intermediate. As it is the large majority lie in the same stature groups as the Europeans, between 160 and 180 cm. The stature groups of the African females are the same as those of the European females, but the index is much less.

## OCEANIC NEGROIDS

The median index of the male is 50.5, the lowest is 44.2 in Australia, and the highest is 52.8 among the Sakai. The index would be considerably lower if the groups mixed with Malay or Asiatic were excluded. Lower indices are found among the Australians than among any groups in Africa and the stature is also lower. The length of the torso and the lower extremities are further apart among the Pacific Islanders than among Africans because of the lower index of the Australians and the higher index of the Mongoloid elements and Pigmy Negritos. The low index among the Australians diminishes through the Melanesians, Negritos and Sakais, to the Malay, although some of the groups among the Malays are very negroid and much like the Negrito. The majority of the stature groups of the male Pacific Negroids are found between 160 and 170 cm. The stature groups of the female Pacific Negroids are found between 140 and 160 cm. which is the same as the Malays and Asiatics, but is different from the Europeans, Africans and American Indians.

## MALAYS

The median index of the male is 52.3, the lowest is 48.6 in the Singalese, and the highest is 53.4 in the Filipinos. There is not an orderly decrease in the index with increase in stature as in the other groups, and the reason for this is that the Malays are very much mixed as noted before. The mainland in India and the Malay Peninsula, as well as the large islands of the Pacific near the mainland and not far from Australia, such as Ceylon, Sumatra, Java, Borneo and several of the Philippines retain evidence of Negrito or Negro influence, and remnants of Negrito tribes may be found in most if not all of the islands. This invariably gives a low sitting height where the type is like the African Negro, but where the type is like the Pigmy or when mixed with the Asiatic the index is high. The stature is low because both the Negrito and the southeastern Asiatic have low stature. Some of the tribes of the interior of the large islands, such as the Kalingas of northern Luzon who are practically pure Europeans in type have tall statures which may be as high as 180 cm. or higher.

## ASIA INCLUDING THE AINO

The index of the male and female is the same even with different statures. The median index of the male is 53.2, the lowest is 50.8 in India, and the highest is 54.1 in Samoyeds. The low index of India is the result not only of the Negrito influence but also of the Mediter-

raneean, which is profusely distributed throughout India. The high index of Siberia and southeast Asia (Annam, for example) is the result of the type of infantile form, the hypo-ontomorph. The males have a homogeneous, intermediate stature, and the index is practically the same in the two stature groups, 53.2. The stature of the females is also homogeneous, but rather small. The index is practically the same as that of the males, except that the Aino has a higher index, 53.7.

#### AMERICAN INDIANS AND ESKIMO

The median index of the males is 52.5, the lowest is 50.1 for the Machiganga of South America, and the highest is 54.9 for the Kwakiutl of Canada; and for females the median is 52.8, the lowest 51.1 in the Maricopas, and the highest is 55.7 among the Eskimos. The Canadians have an index in the female of 55.4 in one group. The Canadian Indians are similar to the Eskimos in this respect and not unlike the Siberians. A number of groups of Indians in South America and Central America besides the Machiganga have low indices, such as the Arowaks; but the Pimas, Papagos and Sioux also have low indices by some authors, although the stature is high, or *because* the stature is high. This may point to Negro mixture in some cases or it may be on account of local conditions and stature.

The stature of the American Indian males lies nearly all below 170 cm. which is like that of the European males. The females have a stature chiefly between 150 and 160 cm.

#### GENERAL SUMMARY

The sitting height depends upon age, stature, sex, race and type, as well as evolution, environment and individual development, and in any consideration of this measured part of the body all of the factors should be known.

#### AGE

The sitting height grows more rapidly during and after puberty than before. It remains stationary between 25 and 60 years and decreases thereafter. Girls are precocious and boys retarded in the growth of the sitting height.

#### THE MORPHOLOGIC INDEX

This index is devised as a factor which represents the percentage difference, of any group, person, type, index or measurable character, from a standard selected as the approximate general norm or average.



The norm should be as near the average for mankind as a whole, as it is possible to reach with our present state of knowledge.

We may use stature to illustrate. Taking the mean standard stature as 165 centimeters, then a person, type or group of people with a stature of 181.5 centimeters would have a morphologic index of +10, and a person, type or group of people with a stature of 148.5 centimeters would have a morphologic index of -10. The morphologic index is +10 because the stature is 10 per cent above the normal standard, and the index is -10 because the stature is 10 per cent below the normal standard.

From a study of all peoples it seems expedient to adopt here a normal standard for stature, sitting height and sitting height index, that may serve as a basis for computing the morphologic index. This standard will be adopted chiefly on the basis of the European records, and as far as the stature is concerned it is the same as that generally used by anthropologists as the central norm about which all the statures of the world may be most conveniently grouped. The standards adopted are: For males: Stature, 165.0 cm., Sitting height 85.0 cm., Sit. Ht. Ind. 52.5; For females: Stature, 155.0 cm., Sitting height, 80.0 cm. Sit. Ht. Ind. 53.5.

The morphologic index has been calculated for all the groups on which there are sufficient data, and the results have been combined and illustrated in charts V, VI, and VII.

In chart V the most distinctive characteristic of the morphologic index for stature is the low index for Central America and the Pacific.

In chart VI for sitting height the morphologic index is seen to be high in Europe, Asia and North America, and low for Central America.

In chart VII for the sitting height index the morphologic index is high for Asia and extremely low for Africa.

#### TYPE

Where short legged people live, conditions of life are difficult. The two great areas occupied by these people are tropic and arctic desert, where only with difficulty can a meager supply of food be obtained. The result has been that through selection and the survival of the fittest environment has produced a resistant type. By desert is meant jungle and ice of tropic and arctic region respectively.

In a general way we may say that each large group of people has its Hypo-ontomorph, or incompletely metamorphosed form: The Aino for the European; the Siberian, Indo Chinese and Malay for the Asiatic;

the Pigmy and Negrito for the African; and the Eskimo for the American Indian. These forms do not represent those who have failed to develop

# MORPHOLOGIC INDEX OF STATURE

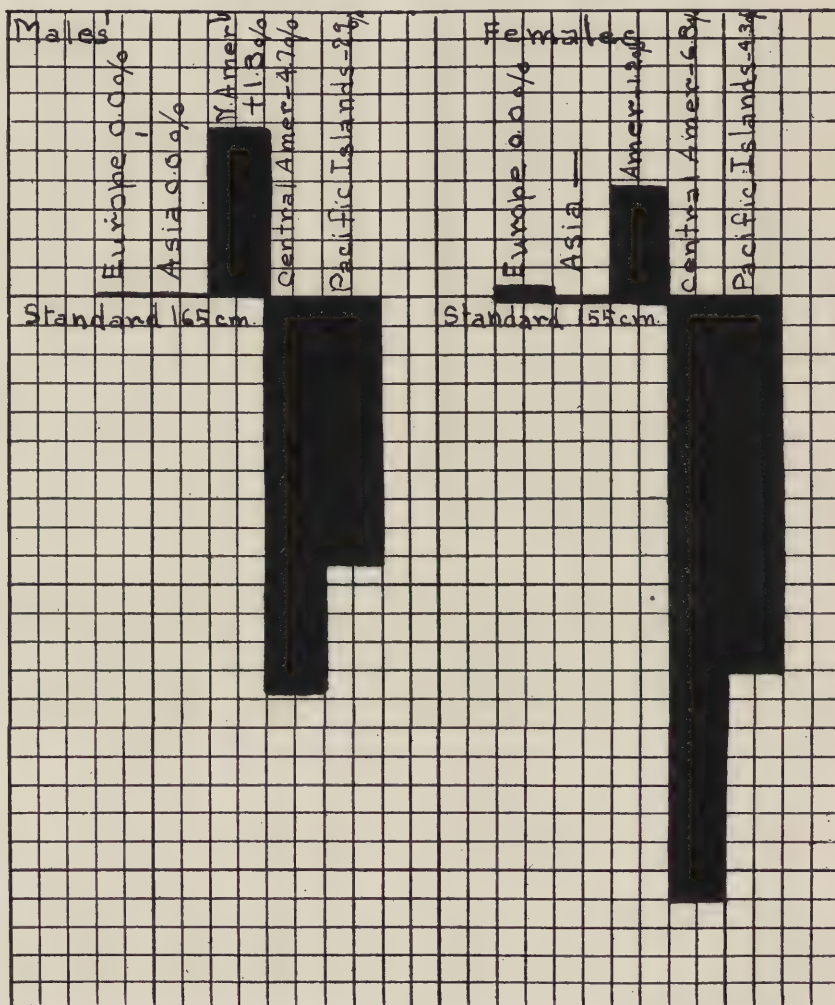


CHART V

through evolution but a regressive condition probably caused by the adverse environment.

At the other extreme are to be found certain groups that seem to have undergone excessive metamorphosis. Such are the Mediterranean for

the European, the Japanese for the Asiatic, and the long legged Negrito for the African. These are the extreme Hyper-ontomorph types of the stock to which they belong.

The Hypo-ontomorph may be looked upon as the type which metamorphoses so slowly that growth is completed before complete metamorphosis is reached, and the Hyper-ontomorph metamorphoses so

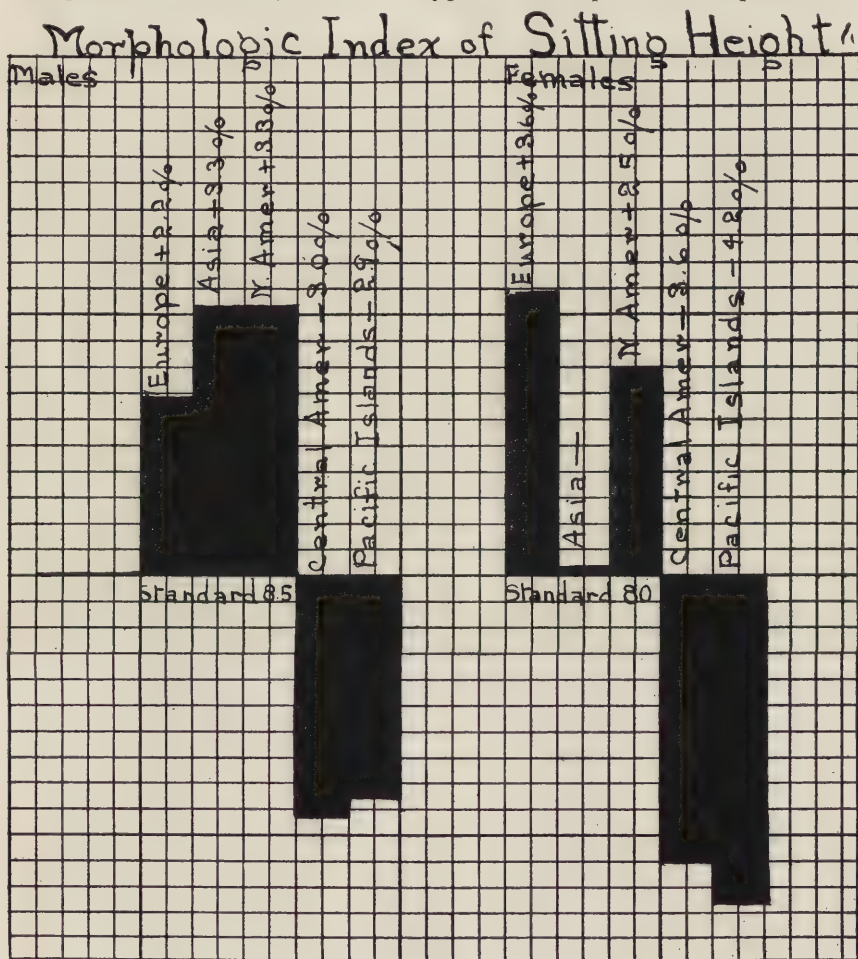


CHART VI

rapidly that growth is incomplete when complete metamorphosis is reached, at which time growth ceases. Growth is less in either case than with intermediate forms. Between these two extremes lies the great



body of each continental mass, which is the Meso-ontomorph of the stock. This mass carries that from which future variants may spring, under varying conditions. Intergrades may become distinct through segregation and environmental conditions. A combination of inter-

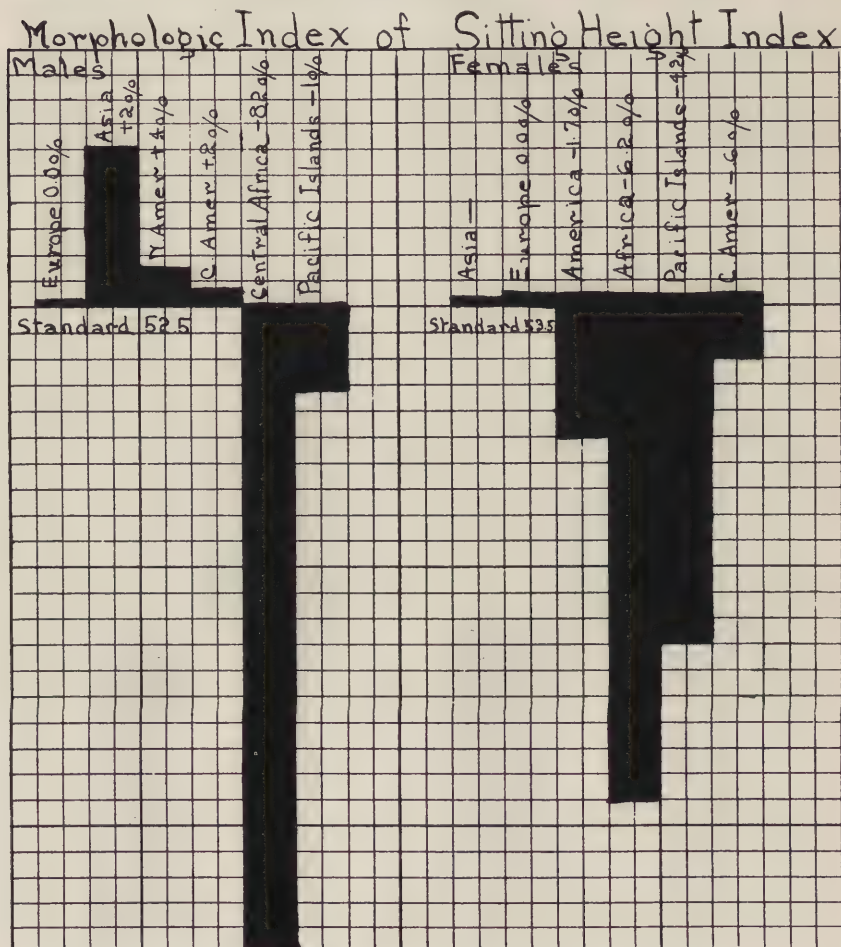


CHART VII

grades may produce many varieties through crosses that result in mixtures, blends, impure or incomplete segregates, mosaics and composites.

The Asiatic has the sitting height accelerated early and retarded late in growth, the growth of the sitting height in the African is late and short, and the European is in between.

## RACE

The Asiatic has a long torso and short extremities, the African has a short torso and long extremities, and the European is in between.

Race movements have altered the stock. There are two areas of extremely low sitting height, Central Africa and Australia, and radiating from these areas the sitting height increases. There are two centers of high sitting height, tropical and arctic, where people live under adverse environment.

## STATURE

The sitting height is inverse to the stature: with small stature the sitting height is relatively great and with a large stature the sitting height is relatively less, within the race. Between races this is not true. The Negro, regardless of stature, has a lower sitting height than any other people.

The sitting height index is a percentage of the stature. When the type is Hyper-ontomorph the index is low and when the type is Hypo-ontomorph the index is high. It is greater in the female than the male, even when they are of the same type and stature.

## CONCLUSIONS

In any evaluation of the sitting height five factors should be known: Age, sex, race, type, and stature.

Sexual, racial and type differences appear during growth, and continue in the adult.

Racial differences that remove the Negro further from the remainder of mankind than any other group of people have been demonstrated.

Differences as the result of environment through isolation and selection appear.

Differences as the result of stature both during growth and in the adult and in races are evident.

The activities of the hormones may aid in the solution of the relations of the growth and metamorphosis of the torso and the extremities, and thus help to an understanding of problems brought out by a study of the sitting height, after we have learned more about the activities of the hormones. The thyroid gland is known to accelerate metamorphosis, therefore the Hyper-ontomorph may be looked upon as the result of high thyroid activity. The lack of thyroid activity or high thymus activity may be present in the Hypo-ontomorph, as in achondroplastic dwarfs. The gonads and the hypophysis play a rôle in determining the

ultimate size and sexual characteristics of the body. The interactions of the endocrine glands may be the key to the differences in type, in sex and in race.

TABLE VIII.  
MALES. STATURE, 140.0 TO 149.9 CENTIMETERS.

Number	Group	Stature	Sitting height	Sitting height Index	Author
5	Sakai	149.1	67.4	49.7	Duckworth
231	Negrito	146.8	74.3	50.6	Newton (Hrdlička)
34	German			53.1	Pfitzner
26	Filipino	149.7	79.9	53.4	Bobbitt
9	Pigmy	148.6	80.7	54.3	Poutrin
8	Pigmy	148.0	82.2	55.5	Poutrin

MALES. STATURE, 150.0 TO 159.9 CENTIMETERS.

6	Toureg vassals	158.5	77.5	48.8	Verneau
14	Bushmen	155.3	77.0	49.5	Werner
119	Niger	159.4	81.0	50.8	Tremearne
18	Machiganga	155.9	78.1	50.1	Ferris
7	Borneo	156.0	79.5	50.9	Rose & McDougal
6	Balek Papau	153.6	78.3	51.0	Garrett
72	Bushmen	156.4	80.0	51.0	Seiner
10	Kanikar	153.6	78.7	51.2	Schmidt
16	Arawaks	155.0	79.2	51.2	Ten Kate
3					
tribes	Arawaks	159.4	81.8	51.4	Farrabee
10	Eskimo	157.7	81.1	51.4	Duckworth
11	Pulayar	157.8	81.2	51.5	Schmidt
42	Borneo	157.3	81.0	51.5	Rose & McDougal
30	Kurumbar	156.3	80.7	51.6	Schmidt
94	Borneo	155.8	80.5	51.6	Rose & McDougal
49	Borneo	158.9	82.0	51.6	Rose & McDougal
	Ba Tua	152.2	78.8	51.8	Poutrin
5	Ulladem	151.5	78.6	51.8	Schmidt
13	Borneo	153.9	79.7	51.8	Rose & McDougal
14	Irular	155.4	80.7	51.9	Schmidt
4	Pigmy	154.0	80.1	52.0	Poutrin
6	Bulangen	157.8	82.0	52.0	Garrett
37	Malay Pen.	158.4	82.4	52.0	Annandale & Robinson
37	Sundanese	159.1	83.0	52.0	Garrett
10	Quichua (mix.)	158.0	82.2	52.0	Chervin
13	Bushmen	152.5	78.0	52.1	Seiner
13	Semang	152.4	79.7	52.2	Annandale & Robinson
13	Sakai	156.3	81.5	52.2	Knocker



TABLE VIII—continued

Number	Group	Stature	Sitting height	Sitting height Index	Author
5	Malay	153.1	79.8	52.2	Schmidt
78	Jews	159.4	83.3	52.2	Weissenberg
21	Kota	159.8	83.6	52.3	Schmidt
2,276	Mex. & C. Amer.				
	Indian	157.5	82.6	52.4	Starr
33	Dyaks	157.0	82.5	52.5	Knocker
80	Quichua	158.4	83.0	52.5	Ferris
17	Javanese	157.1	82.5	52.5	Garrett
6	Bugis	154.4	81.2	52.6	Knocker
183	Filipinos	159.5	83.8	52.6	Bean
277	German			52.6	Pfützner
25	Fuegians	157.7	83.0	52.7	Hyades & Deniker
10	India	158.1	83.3	52.7	Hagen
12	Pigmy	158.4	83.5	52.8	Poutrin
26	Sakai	152.3	80.5	52.8	Annandale & Robinson
90	Aino	156.8	83.0	52.8	Koganei
124	Quichua	158.3	83.7	52.8	Ferris
13	Spuzzum	159.7	84.5	52.8	B. A. A. S.
10	Shuswap	155.4	82.4	52.9	B. A. A. S.
75	Voguls	156.7	82.9	52.9	Rudenko
24	Quichua	158.7	84.0	53.0	Ferris
67	Quichua			53.0	Chervin
10	Harrison Lake	158.0	84.0	53.1	B. A. A. S.
12	Pigmy	155.1	82.5	53.2	Poutrin
4	Pigmy	151.2	80.6	53.3	Poutrin
127	Ostiaks	156.5	83.6	53.3	Rudenko
5	"Mallasque"	154.2	82.7	53.7	Rivet
53	Samoyeds	156.8	84.8	54.1	Rudenko
17	Aymara	156.4	85.0	54.6	Forbes
104	Aymara	159.7	87.6	54.8	Chervin

MALES. STATURE, 160.0 TO 169.9 CENTIMETERS.

19	Australia	166.4	77.5	46.8	Spencer & Gillen
16	Singalese	160.5	78.0	48.6	Deschamps
95	Kanembu	167.6	82.0	49.0	Gaillard & Poutrin
55	Oulad-Shinon	169.3	83.1	49.1	Gaillard & Poutrin
19	Papuan	165.6	81.6	49.2	Chalmers
20	Papuan	163.6	80.7	49.3	Chalmers
33	Teda	169.6	84.0	49.6	Gaillard & Poutrin
16	Papuan	167.7	84.0	49.9	Spencer & Gillen
14	Papuan	162.8	81.4	50.0	Hagen
82	Amboras	168.6	84.3	50.1	Verneau

TABLE VIII—continued

Number	Group	Stature	Sitting height	Sitting height Index	Author
44	M'Baka	167.1	84.2	50.4	Poutrin
15	Papuans	160.9	81.0	50.4	Schellong
18	Bondjio	163.0	82.5	50.6	Poutrin
25	Ba-Téké	162.1	82.5	50.7	Poutrin
77	Pima	169.6	86.0	50.7	Ten Kate
	Arawaks	161.5	81.8	50.7	Farrabee
25	Somali	165.5	84.5	50.8	Puccioni
27	Malser	162.1	82.5	50.8	Schmidt
44	Tamil	161.8	82.0	50.8	Hagen
	Batua	160.1	81.8	51.0	Poutrin
583	Amer. Negro	169.7	86.6	51.0	Bean
18	Papago	169.6	86.6	51.1	Ten Kate
57	Porto Rico	168.7	86.3	51.2	Boas
28	Badaga	163.9	83.8	51.2	Schmidt
20	Schonar	166.2	85.0	51.2	Schmidt
150	Egypt	163.4	84.1	51.3	Hrdlička
54	Kaffirs	166.2	85.3	51.4	Suk
32	Papuans	160.6	82.5	51.4	Schellong
200	Little Russian	166.9	85.2	51.4	Diebold
13	Melanesians	163.3	84.0	51.4	Hagen
9	Melanesians	161.7	82.5	51.4	Hagen
105	Javanese	160.4	82.5	51.5	Kohlbrugge
28	Pariah	162.5	83.7	51.5	Schmidt
22	Toda	169.0	87.2	51.6	Schmidt
30	Tatars	164.2	85.0	51.6	Benzengue
100	Jews	162.8	84.2	51.6	Blechman
99	Zapotec	160.5	83.0	51.6	Starr
15	Lolas	162.5	83.5	51.6	Delisle
27	Malay	160.0	83.0	51.6	Hagen
67	Berbers	164.3	85.2	51.7	Topinard
100	Paris insane	165.0	85.4	51.7	McAuliffe
304	East India	161.9	83.6	51.7	Schmidt
17	Brahman	162.6	84.4	51.8	Schmidt
23	Wellala	163.9	85.2	52.0	Schmidt
23	Sudra	165.9	86.2	52.0	Schmidt
100	Jews	165.1	86.0	52.0	Weissenberg
100	Taraskan	160.0	83.2	52.0	Starr
15	Nkamtúnemuq	165.7	86.3	52.0	B. A. A. S.
12	Lilloet	162.3	84.5	52.0	B. A. A. S.
127	Russians			52.0	Mainow
11	Melanesians	161.7	84.0	52.0	Hagen
18	Ntlakypamuq	162.7	84.7	52.1	B. A. A. S.
780	Tsiganes	164.9	86.6	52.1	Pittard

TABLE VIII—continued

Number	Group	Stature	Sitting height	Sitting height Index	Author
38	Filipinos	160.9	84.0	52.2	Bean
50	French Lorraine	169.6	88.4	52.2	Collignon
	Jews (London)	165.1	86.3	52.2	Jacobs & Spielman
105	Shoshonean	166.1	86.7	52.2	Boas
7	Batavian	163.4	85.5	52.3	Garrett
100	Balkans	163.5	85.5	52.3	Pittard
100	French	166.0	86.8	52.3	Collignon
100	Normandy	168.1	88.0	52.3	Garnier-Moronval
38	Shuswap	165.2	86.7	52.4	B. A. A. S.
748	German			52.4	Pfitzner
377	Filipinos	163.3	85.8	52.5	Bean
100	French	165.1	86.8	52.5	
33	Chilcotin	165.1	86.8	52.5	B. A. A. S.
	Jews (English)	163.3	85.0	52.5	Jacobs & Spielman
125	Greeks	167.4	88.0	52.5	Pittard
100	French	164.0	86.1	52.5	Collignon
13	Lolos	168.4	88.5	52.6	Legendre
11	Eskimo	167.9	88.2	52.6	Boas
2,341	Tatar	163.6	86.1	52.6?	Pittard
40	Battaks	160.0	84.2	52.6	Hagen
41	Malays	161.5	84.8	52.6?	Hagen
29	Lolos	167.5	88.3	52.7	Legendre
100	Paris normal	165.1	86.8	52.7	McAuliffe
10	Sudanese	160.8	84.8	52.7	Hagen
30	French	163.6	86.3	52.7	Collignon
10	Lolos	166.7	88.1	52.8	Legendre
	Jews (London)	163.3	86.5	52.9	Jacobs & Spielman
7	Amer. Indian	166.3	88.4	52.9	Boas
12	Lilloet	164.3	87.0	52.9	B. A. A. S.
10	Sundanese	161.8	85.5	52.9	Hagen
100	Balkans	169.0	89.5	53.0	Pittard
	Jews (English)	168.8	89.3	53.0	Jacobs & Spielman
98	Tungus	163.1	86.5	53.0	Mainow
30	Thibet	164.3	85.9	53.0	Delisle
117	Chinese of Annam	164.6	83.6	53.1	Vaillant
207	Jakuts	162.4	86.2	53.1	Mainow
	English	169.8	90.0	53.1	Galton
90	Chinese South	168.5	89.7	53.2	Koganei
68	Bashkiri	165.7	88.2	53.2	Weissenberg
15	Maschtscherjaken	163.6	87.2	53.2	Weissenberg
60	Apache	169.7	90.3	53.2	Hrdlička
12	Utàm'k't	161.0	85.7	53.2	B. A. A. S.
	Jews (English)	160.8	85.0	53.2	Jacobs & Spielman



TABLE VIII—continued

Number	Group	Stature	Sitting height	Sitting height Index	Author
49	Chinese	161.4	86.0	53.2	Hagen
70	Java	161.4	86.0	53.2	Hagen
51	Filipinos	162.1	86.7	53.4	Bobbitt
100	Chinese	161.1	86.2	53.4	Legendre
53	Balkans	166.4	88.8	53.4	Pittard
307	Siberia	164.6	88.3	53.5	Paissel
12	Eskimo	167.5	89.7	53.5	Boas
92	Kalmucks	163.1	88.0	53.5	Karolew
125	Armenians	166.1	89.0	53.6	Pittard
942	Chinese	167.5	89.7	53.7	Koganei
181	Buriats	163.1	87.5	53.7	Schendrekowski
100	Esthonians	164.3	88.2	53.7	Gruber
20	Nass River	167.0	90.0	53.7	B. A. A. S.
69	Annam	162.3	87.6	53.8	Roux
24	Bilqula	166.0	89.6	53.8	B. A. A. S.
150	Mordvini			53.8	Mainow
105	Armenians	167.1	90.5	54.1	Tvarjanovic
61	Eskimo	162.7	88.3	54.3	Moore
18	Tinneh	163.7	89.0	54.4	B. A. A. S.
36	Kwakiutl	164.4	90.2	54.9	B. A. A. S.

## MALES. STATURE, 170.0 TO 179.9 CENTIMETERS.

21	Australia	172.4	76.3	44.2	Spencer & Gillen
141	Niger	177.2	84.0	47.4	Tremearne
85	Bulala	175.2	83.0	47.4	Couv
25	Mongawa	171.0	82.0	47.9	Gaillard & Poutrin
30	Kouri	173.0	83.7	48.4	Gaillard & Poutrin
739	Niger	172.1	83.5	48.5	Ruelle
19	Toureg	172.1	84.0	48.8	Verneau
37	Niger	172.1	84.5	49.2	Tremearne
105	Bondamme	173.0	85.0	49.2	Gaillard & Poutrin
116	Niger	176.0	86.5	49.2	Tremearne
36	Toureg nobles	175.1	86.2	49.2	Verneau
41	Dahomey	176.3	87.2	49.4	Verneau
16	Papuans	170.2	84.3	49.5	Chalmers
142	Niger	173.0	86.2	49.8	Tremearne
111	West Africa	170.0	85.7	50.4	Verneau
152	Niger	170.5	86.2	50.5	Tremearne
688	Amer. Negro	172.9	87.2	50.5	Bean
29	Maricopa	172.2	87.8	50.8	Ten Kate
	Polynesians	175.5	89.6	51.0	Ten Kate
14	Polynesians	172.8	88.2	51.0	Ten Kate

TABLE VIII—continued

Number	Group	Stature	Sitting height	Sitting height Index	Author
100	Livonians	173.5	89.4	51.4	Waldhauer
536	Sioux	172.9	88.9	51.4	Sullivan
24	Balkans	178.5	92.0	51.6	Pittard
77	Sioux mix.	173.5	89.3	51.6	Sullivan
15	Tatar	178.5	91.9	51.6	Pittard
63	Kurds	170.0	88.2	51.8	Pittard
60	Lithuanians	170.5	88.8	51.9	Walber
295	German			52.1	Pfitzner
364	Canada	170.9	88.2	52.4	Pittard
2,066	Amer. white	174.0	91.1	52.4	Bean
17	Amer. Indian	171.0	90.3	52.8	Boas
	Jews London	171.2	90.7	52.9	Jacobs & Spielman
35	Pima Indians	171.8	91.0	52.9	Hrdlička
	Old American	174.3	92.3	52.95	Hrdlička
	English	172.5	91.5	53.0	Galton

## MALES. STATURE, 180.0 TO 189.9 CENTIMETERS.

6	Niger	187.1	88.0	47.0	Verneau
140	Niger	184.0	90.8	49.3	Tremearne

## FEMALES. STATURE BELOW 140.0 CENTIMETERS.

25	C. Amer.	139.9	76.2	54.5	Starr
120	Negrito	138.8	71.1	51.2	Newton

## FEMALES. STATURE 140.0 TO 149.9 CENTIMETERS.

3	Semang	140.8	65.7	46.7	Duckworth
1	Borneo	148.0	71.6	48.3	Rose & McDougal
1	Borneo	146.5	73.8	50.3	Rose & McDougal
17	Bushmen	149.7	75.5	50.5	Werner
18	Bushmen	148.2	72.2	51.0	Seiner
3	Borneo	145.0	74.6	51.4	Rose & McDougal
2					
tribes	Arawaks	147.9	76.5	51.7	Farrabee
25	Dyaks	145.4	75.5	51.8	Rose & McDougal
15	Machiganga	143.9	74.2	51.8	Ferris
6	Borneo	149.3	77.6	51.9	Rose & McDougal
13	Ba Tua	143.7	75.4	52.5	Poutrin
4	Sakai	144.3	76.5	52.8	Knocker
223	German			53.0	Pfitzner
63	Filipino	147.8	78.5	53.1	Bean
573	Mex. & C. Amer.	145.3	77.2	53.1	Starr

TABLE VIII—continued

Number	Group	Stature	Sitting height	Sitting height Index	Author
7	Pigmy	143.5	76.2	53.1	Poutrin
53	Fuegians	147.3	78.2	53.1	Hyades & Deniker
17	Eskimo	149.7	79.7	53.2	Duckworth
5	Pigmy	144.3	77.0	53.3	Poutrin
26	Filipino	149.7	80.0	53.4	Bobbitt
55	Aino	146.8	78.4	53.4	Koganei
3	Aino	142.7	77.3	54.2	Koganei
13	Aino	149.5	81.6	54.6	Koganei
7	Aymara	147.8	80.6	54.6	Chervin
68	Quichua	145.4	80.4	55.6	Ferris

## FEMALES. STATURE 150.0 TO 159.9 CENTIMETERS.

17	Australians	159.1	76.0	47.6	Spencer & Gillen
10	Australians	156.8	76.0	48.4	Spencer & Gillen
24	Sioux (old)	157.7	78.8	49.9	Sullivan
10	West Africans	158.3	79.7	50.5	Verneau
54	Negro	155.7	79.0	50.8	Poutrin
10	Polynesians	159.1	81.7	51.3	Ten Kate
5	Papago	157.6	81.0	51.5	Ten Kate
51	Pima	156.3	80.7	51.6	Ten Kate
19	Lilloet	152.5	79.2	51.8	B. A. A. S.
12	Nkamtnemuq	157.7	82.1	52.1	B. A. A. S.
30	Pima	157.4	82.2	52.3	Hrdlicka
35	Okanagau	156.5	82.0	52.4	B. A. A. S.
62	Jakuts	153.4	79.5	52.4	Mainow
18	Thibet	152.6	80.0	52.4	Delisle
6	Eskimo	155.6	81.5	52.4	Boas
3	Borneo	159.5	83.8	52.5	Rose & McDougal
14	Gillooet	154.2	81.1	52.6	B. A. A. S.
	Ntlalsyapamup6	153.0	80.7	52.7	B. A. A. S.
28	Shuswap	155.0	81.8	52.8	B. A. A. S.
29	Apache	157.2	83.0	52.8	Hrdlicka
21	Shoshonean	152.8	80.8	52.8	Boas
430	Tsiganes	153.2	81.2	52.9	Pittard
612	Germans			52.9	Pfitzner
25	Chinese	151.5	80.4	53.0	Pyle
38	Balkans	154.7	82.7	53.5	Pittard
17	Utâmk	153.2	81.5	53.6	B. A. A. S.
	English	158.3	84.8	53.6	Galton
6	Eskimo	151.5	81.2	53.7	Boas
8	Quichua	154.1	83.2	53.8	Chervin
52	Jakuts	150.0	72.5	54.2	Mainow



TABLE VIII—continued

Number	Group	Stature	Sitting height	Sitting height Index	Author
10	Tungus	150.0	81.0	54.2	Mainow
	Jews English	152.0	82.5	54.3	Jacobs & Spielman
17	Nass River Indians	154.3	84.3	54.7	B. A. A. S.
33	Kwakiutl	153.7	80.7	55.4	B. A. A. S.
46	Eskimo	151.7	84.6	55.7	Moore

## FEMALES. STATURE, 160.0 TO 169.9 CENTIMETERS.

33	Niger	163.9	78.5	47.9	Ruelle
18	Maricopa	160.1	82.0	51.1	Ten Kate
44	Kaffir	161.0	82.6	51.4	Suk
156	Sioux	160.0	82.4	51.4	Sullivan
19	Sioux (mix.)	161.2	82.8	51.4	Sullivan
197	German	165.0	87.0	52.6	Pfitzner
	English	160.8	86.1	53.5	
200	Old American	161.8	87.35	54.—	Hrdlička

## BIBLIOGRAPHY

- Annandale (N.) & H. C. Robinson—Fasciculi Malayensis. London, 1903.
- Bardeen (C. R.)—The Height-Weight Index of Build in Relation to Linear and Volumetric Proportions and Surface Area of the Body During Post-Natal Development. *Contributions to Embryology*, Carnegie Inst. Wash., 1920, IX, No. 46, 483-554.
- Barr (Anne L.)—Some Anthropometric Measurements of Western College Girls. *Am. Phys. Educ. Rev.*, 1903, VIII, 245.
- Baxter (J. H.)—Statistics, Medical and Anthropological. Wash., 1875.
- Bean (R. B.)—Filipino Types. *Philip. J. Sc.*, 1909, IV, 359-449;—The Racial Anatomy of the Philippine Islanders. Philadelphia, 1909;—The Stature and the Eruption of the Permanent Teeth. *Am. J. Anat.*, 1914, XVII, No. 1, 113-160;—Some Characteristics of the External Ear. *Am. J. Anat.*, 1915, XVIII, No. 2, 201-225.
- Bent (J. T.)—The Sacred City of the Ethiopians. London, 1893.
- Benzengre (B.)—Étude anthropologique sur les Tatars de Kassimoff. *Rev. d'Anthrop.*, 1881.
- Blechman (B.)—Ein Beitrag zur Anthropologie der Juden. Dorpat, 1882.
- Boas (F.)—A. J. Stone's Measurements of the Natives of the Northwestern Territories. *Bull. Am. Mus. Nat. Hist.*, 1901, XIV, 53-68;—Anthropometry of Shoshonean Tribes. *Amer. Anthropol.*, 1899, N. S., I, 751-758.
- Bobbitt (J. F.)—The Growth of Filipino Children. *Pedag. Sem.*, 1909, XVI.
- Bowman (E.)—Antiquités de la region Andine de la République Argentine et du desert d'Atacama. Paris, 1908, II, 524.
- British A. A. S. Reports On the Northwestern Tribes of the Dominion of Canada. 1892, 1895, 1898.

- Chaillon (A.)—Considération général sur quatre types morphologiques humaines. *Bull. & Mém. Soc. Anthropol.*, Paris, 1910, Sér. 6, I.
- Chalmers (J.)—Toaripi. Anthropometrical Observations on Some Natives of the Papuan Gulf. *J. R. Anthropol. Inst.*, 1898, XXVII, 326-342.
- Chervin (A.)—Anthropologie Bolivienne. Paris, 1907, II, 171, 253.
- Collignon (R.)—Étude anthropométrique élémentaire des principales races de France. *Bull. Soc. Anthropol.*, Paris, 1883, VI, 463-526.
- Corrêa (A. A. Mendes)—Antropologia Angolense. *Arch. f. Anat. & Antrop.*, 1916, II, No. 4, 323-356.
- Couvy (D.)—Notes anthropométriques sur quelques races du territoire militaire du Tchad. *L'Anthropol.*, 1907, XVIII, 549-582.
- Crook (A. H.)—Measurements of the Chinese. *Nature*, 1908.
- Delisle (E.)—Sur les caractères physiques des populations du Thibet sud-oriental. *Bull. Soc. Anthropol.*, Paris, 1908, IX, sér. 5. No. 4, 473-485.
- Deschamps (E.)—Les Veddas de Ceylon et leur rapports avec les peuples environnants, les Rhodias et les Singales. *L'Anthropol.*, 1891, II, 297-337.
- Diebold (W.)—Ein Beitrag zur Anthropologie der Kleinrussen. Dorpat, 1886.
- Downes (R. M.)—The Interrelationships of Some Trunk Measurements and Their Relation to Stature. *J. Anat. & Physiol.*, 1914, XLVIII.
- Duckworth (W. L. H.)—On the Anthropometric Data Collected by Prof. J. Stanley Gardiner in the Maldine Islands and Minikoi. *Proc. Camb. Phil. Soc.*, 1913, XVII;—An Account of Some Eskimo From Labrador, 1900, X, 286;—Some Anthropological Results of the Skeat Expedition to the Malay States. *J. Anthropol. Inst.*, 1902, XXXII, 142-152.
- Elderton (Ethel M.)—Height and Weight of School Children in Glasgow. *Biometrika*, 1914-15, X, 288.
- Ethnographic Survey of India.* Data from Bombay and Burma. 1906-7.
- Ferris (H. B.)—The Indians of Cuzco and the Apurimac. *Mem. Am. Anthropol. Ass.*, 1916, III;—Anthropological Studies on the Quichua and Machiganga Indians. *Trans. Conn. Acad. Arts & Sc.*, 1921.
- Forbes (D.)—On the Aymara Indians of Bolivia and Peru. *J. Ethnol. Soc.*, London, 1870, N. S., II, 193-205.
- Fulleborn (F.)—Beiträge zur physischen Anthropologie der Nord-Nyassa-Länder. Berlin, 1902.
- Galton (F.)—Some Results of the Anthropometric Laboratory. *J. Anthropol. Inst.*, 1885, XIV, 275-287.
- Garnier-Moronval (M.)—Recherches anthropométriques sur les Normands. *L'Anthropol.*, 1913, XXIV, 25.
- Garrett (T. R. H.)—The Natives of the Eastern Part of Borneo and Java. *J. Anthropol. Inst.*, 1912, XV, 53-63.
- Giuffrida-Ruggeri (V.)—Le proporzioni del busto nei due sessi e i canon di Fritsch. *Atti Soc. Rom. Antrop.*, 1907, XIII, 45;—Documenti sull'indice schelico. *Riv. di Antrop.*, 1916, XX;—L'Indice schelico nei due sessi. *Riv. di Antrop.*, 1917, XXI.
- Gladstone (R. J.)—Brain Weight of Man. *Brit. Med. J.*, 1906.
- Godin (P.)—Recherches anthropométriques sur la croissance des diverses parties du corps. 1913;—Les proportions du corps pendant la croissance. *Bull. & Mém. Soc. Anthropol.*, Paris, 1910;—Lois de croissance. *J. Anthropol. Inst.*, 1914, XLIV, 295-301.

- Gould (B. A.)—Investigations in the Military and Anthropological Statistics of American Soldiers. *U. S. Sanit. Comm. Mem.*, 1869.
- Grube (O.)—Anthropologische Untersuchungen an Esten. Dorpat, 1878;—*Anthrop. Atlas Ostasiatischer und Melanischer Völker*. Wiesbaden;—*Die Orang Kubu auf Sumatra*. Frankfort-am-Main, 1908.
- Hagen (B.)—*Anthropologische Studien aus Insulinde*. Amsterdam, 1890.
- Hall (W. S.)—The Changes in the Proportions of the Human Body During Growth. *J. Anthrop. Inst.*, 1896, XXV, 21–46.
- Hastings (W. W.)—*A Manual for Physical Measurements*. Springfield, 1902.
- Hitchcock (E.)—*Anthropometric Manual of Amherst College*, 1900.
- Hrdlička (A.)—*Anthropological Investigations on One Thousand White and Colored Children of Both Sexes*, 1900;—*Physiological and Medical Observations among the Indians of Southwestern United States and Mexico*. *Bull.* 34, Bur. Am. Ethnol., 1902;—*The Natives of Kharga Oasis*. *Smithson. Misc. Coll.*, 1902, 59;—*Anthropometry*. 8 vo., Wistar Inst., Philadelphia, 1921;—*Anthropology of the Old Americans*. *J. Phys. Anthropol.*, 1922, 1923.
- Hyades (P.) and J. Deniker—*Mission scientifique du Cap Horn*. 1891, VII.
- Jacobs (J.) & I. Spielman—On the Comparative Anatomy of the English Jews. *J. Anthrop. Inst.*, 1889–90, XIX, 76–83.
- Knocker (F. W.)—The Aborigines of Sungei Ujong. *J. Anthrop. Inst.*, 1907, X.
- Koganei (Y.)—*Beiträge zur physischen Anthropologie der Aino: 2, Untersuchungen über die Lebenden*. Tokyo, 1894;—*Messungen an Chinesischen Soldaten*. *Mitt. Med. Fac. Univ. Tok.*, 1903, VI, 2.
- Kohlbrugge (J. H. F.)—*Anthropometrische Untersuchungen bei den Dyak*. *Mit. Nied. Reich. f. Völk.*, Haarlem, 1903, V;—*L'Anthropologie des Tenggerois Indonésiens-montagnards de Java*. *L'Anthropol.*, 1898, IX, 1–25.
- Kollman (J.)—Zur Anthropologie der Juden. *Korr.-Bl. d. Ges. f. Anthropol. & Urg.*, 1917, 1–5.
- Korolew (S. A.)—Die Astrachanaschen Kalmucken. *Arch. f. Anthropol.*, 1906, IV, 91.
- Lapicque (M.)—Les nègres d'Asie et la race nègre en générale. *Rev. Sc.*, 1906, VI.
- Legendre (A. F.)—*Étude anthropologique sur les Chinois du Setchuoen*. *Bull. & Mém. Soc. Anthropol.*, Paris, 1910, II, No. 2, 77–94;—*Far West Chinois*.—*Aborigines*.—*Lolos*. *ibid.*, 520–522.
- Mainow (J.)—Die Jakuten. *Arch. f. Anthropol.*, 1904, N. F. XI, 219.
- Manouvrier (L.)—*Étude sur les rapports anthropométriques en générale et sur les principales proportions du corps*. *Mém. Soc. Anthropol.*, Paris, 1902, II.
- Marie (A.)—*L'anthropométrie des Malagaches*. *L'Ethnographie*, 1914, XV.
- Martin (R.)—*Die Inlandstämme der Malaischen Halbinseln*, 1905;—*Lehrbuch der Anthropologie*. Jena, 1914.
- McAuliffe (L.), A. Marie & Thooris—*Résultats des mensurations comparées de 100 soldats et de 100 aliénés épileptiques ou idiots*. *Bull. & Mém. Soc. Anthropol.*, Paris, 1910, I, 307–311.
- McDonald (A.)—*Experimental Study of Children*. *Rep. Comm. U. S. Bur. Ed.*, 1899, 987–1390.
- MacIver (R. D.) & A. Wilkin—*Libyan Notes*, London, 1901.
- Medico-Actuarial Mortality Investigation*. 1912.
- Merker (M.)—*Die Masai*. Berlin, 1910, 2 ed.
- Mills (W. W.)—The Relation of Bodily Habitus to Visceral Form, Position, Tonus and Motility. *Am. J. Roentg.*, 1917, IV, 155.



- Montoudon (G.)—Au pays Ghimirra. Neuchatel, 1913.
- Paissel (W. E.)—Materialen zur Anthropologie der Tarantschen. *Arch. f. Anthrop.*, 1901, XXVI, 176.
- Papillault (G.)—L'homme moyen de Paris. *Bull. Soc. Anthrop.*, Paris, 1902, III, 393-526;—Anthropométrie comparée de nègres africaines et de Français de deux sexes. *Rev. Anthrop.*, 1911, XXI, 331, 536.
- Pfützner (W.)—Social anthropologische Studien: I. Der Einfluss der Lebensalters auf die anthropologischen Charaktere. *Zeitschr. f. Morph. u. Anthrop.*, 1889, I, 325-377;—Die Proportionen des erwachsenen Menschen. *Zeitschr. f. Morph. u. Anthrop.*, 1902-3, V, 201-314.
- Pittard (E.)—La taille, la grandeur du buste et des jambes, l'indice céphalique et l'indice nasal de 253 Tatars de la peninsule des Balkans. *Bull. & Mém. Soc. Anthrop.*, Paris, 1911, II, 432-441. Comparaisons de quelques caractères somatologiques chez les Kurdes et chez les Arméniens. *Rev. Anthrop.*, 1913, XXIII, 98-103. Contribution à l'étude anthropologique des Gagauz. *Rev. anthrop.*, 1916, XXVI, 132.
- Poutrin (L.)—Contribution à l'étude des pygmées d'Afrique (type brachycéphalique). *L'Anthrop.*, 1910, XXI, 435-504;—Notes anthropologiques sur les nègres du Congo français. *Bull. & Mém. Soc. Anthrop.*, Paris, 1910, I, 33-47;—Notes anthropologiques sur les nègres du Congo. *L'Anthrop.*, 1911, XXII, 420-519. (Type sous-dolicocéphalique).
- Poutrin (L.) & R. Gaillard—Étude anthropologique des populations des régions du Tchad et du Kanen. *Doc. scient. mission Tilho*, Paris, 3, 1914.
- Preengruber—Observations anthropométriques sur 184 Kabyles de Palestre. Inedited, courtesy of Collignon-Giuffrida-Ruggeri, 1884.
- Puccioni (N.)—Ricerce antrometriche sui Somali. *Arch. p. l'Antrop. e l'Etnol.*, Firenze, 1911, 302;—Somali, *Ibid*; 1917, XLVII, 13-15.
- Pyle (W. H.)—A Study of the Mental and Physical Characteristics of the Chinese. *School & Society*, 1918, VIII, 264-268.
- Pyle (W. H.) & P. E. Collins—The Mental and Physical Measurements of Rural Children. *Sch. & Soc.*, 1918, VIII, 534-539.
- Ranke (O.)—Beiträge zur Frage des kindlichen Wachstums. *Arch. f. Anthrop.*, 1905, III, 161-180.
- Ranke (J.)—Der Mensch. Leipzig & Vienna, 1912.
- Regnault (F.)—Essai sur les proportions du corps. *Bull. Soc. Anthrop.* Paris, 1905, IV, 276-291.
- Reid (R. W.)—Remarks on 15 years of Anthropometric Work in the University of Aberdeen. *J. Anat. & Physiol.*, 1911-12, IV, 1.
- Retzius (G.) & C. M. Fürst—*Anthropologia Suecica*. Stockholm, 1902.
- Reuter (F.)—Beiträge zur Anthropologie Hinterpommern. *Arch. f. Anthrop.*, 1903, XXVIII, 289-338.
- Rivet—Les Indiens de Mallasque. *Bull. Soc. Anthrop.*, Paris, 1904, V, 144-152.
- Roberts (C.)—The Physical Development and Proportions of the Human Body. *St. George's Hospital Rep.*, 1877, VIII, 1-48;—Manual of Anthropometry. London, 1878.
- A. C. Haddon, in Rose & McDougal,—Pagan Tribes of Borneo. London.
- Roudenko (S.)—Résultats de mensuration anthropologique sur les peuplades du nordouest de la Sibérie. *Bull. & Mém. Soc. Anthrop.*, Paris, 1914, V, 123-143.

- Roux (P.)—Contribution à l'étude anthropologique de l'Annamite Tonkinois. *Bull. Soc. Anthropol.*, Paris, 1906, V, 321-350.
- Ruelle (E.)—Notes anthropologiques, ethnographiques et sociologiques sur quelques populations noire du 2<sup>e</sup> territoire militaire de l'Afrique occidentale française. *L'Anthrop.*, 1904, XV, 657-703.
- Sanchez-Fernandez (L.)—El hombre español util para servicio de las armas . . . sus características antropologicas. *Ass. Español. Prog. Ciencias*, Granada, 1911.
- Seaver (J. W.)—Anthropometry and Physical Examination. New Haven, 1909.
- Seiner (F.)—Beobachtungen und Messungen an Buschleuten. *Zeitschr. f. Ethnol.*, 1912, XLIV, 280-288.
- Schellong (O.)—Beiträge zur Anthropologie der Papuas. *Zeitschr. f. Ethnol.*, 1891, XXIII, 156-230.
- Schendrikowski (J. J.)—Beiträge zur Anthropologie der Sselengaschen Burjäten. *Arch. f. Anthropol.*, 1910, XXVI, 156.
- Schmidt (E.) & P. Bartels—Beiträge zur Anthropologie Sudindiens. *Arch. f. Anthropol.*, 1910, IX, 90-159.
- Smedley (F. W.)—Report of the Department of Child Study. *46th Ann. Rep. Bd. Educ.* Chicago, 1900.
- Spencer (B.) & F. J. Gillen—The Natives of Central Australia, 1899;—The Northern Tribes of Central Australia. 1904.
- Spier (L.)—The Growth of Porto Rican Boys. *J. Dent. Research.*, 1919, I, 1.
- Starr (F.)—Physical Characters of the Indians of Southern Mexico. Chicago, 1902.
- Stratz (C. H.)—Naturgeschichte des Menschen. Stuttgart, 1915;—Betrachtung über Wachstum des Menschen. *Arch. f. Anthropol.*, 1904, XIV, 81-88.
- Suk (V.)—Natives of Natal and Zululand. Unpublished. Courtesy of Dr. A. Hrdlička.
- Sullivan (L. R.)—Anthropometry of the Siouan Tribes. *Am. Mus. Nat. Hist.*, 1920.
- Thurston (E.)—Badagas and Irulas of the Nilgiris. *Madras Gov. Mus.*, 1897;—Anthropology of the Todas and Kotas. *Ibid.*, 1896.
- Ten Kate (H.)—Observations anthropologiques recueillies dans la Guyane et le Vénézuëla. *Rev. d'Anthropol.*, 1887, LXIV;—Mélanges anthropologiques. *L'Anthropol.*, 1914-17, XXV-XXVIII, 519-564, 569-583;—Indigènes de l'Archipel Timorien. *L'Anthropol.*, 1915, XXVI, 519-564.
- Teumin (S.)—Topographisch-anthropometrische Untersuchungen über die Proportions-verhältniss, des weiblichen Körpers. *Arch. f. Anthropol.*, 1901, XXVII, 379.
- Torii (R.)—Les aborigènes de Formosa. *J. Col. Sci. Imp. Univ.* Tokyo, XXIII, 49.
- Topinard (P.)—Rapport sur la population indigène de l'oasis de Biskra. *Bull. Soc. Anthropol.* Paris, 1870, sér. 2, V, 548-555;—Eléments d'anthropologie générale. Paris, 1885.
- Tremearne (A. J. N.)—Notes on the Kagoro and other Nigerian Headhunters. *J. Anthropol. Inst.*, 1912, XV, 136-199.
- Tvarjanovic (J. K.)—Materialen zur Anthropologie der Armenier. *Arch. f. Anthropol.*, 1910, XXVI, 181.
- Vaillant (L.)—Contribution à l'étude anthropologique des Chinois. *L'Anthropol.*, 1920, XXX, 8.
- Verneau (R.)—Anthropologie et ethnologie de l'Ethiopie. 1916;—Résultats anthropologiques de la mission de M. de Gironcourt en l'Afrique occidentale. *L'Anthropol.*, 1917, XXVII, 47, 211, 407, 542; XXVIII, 537, 568.

- Vram (N. G.)—Su alcuni carateri antropologici dei Cicci. *Boll. Soc. Adr. Sc. Nat.*, Trieste, XXI, 216–217.
- Walber (C.)—Beiträge zur Anthropologie der Letten. Dorpat, 1879.
- Waldhauer (F.)—Über Anthropologie der Liver. Dorpat, 1877.
- Weisbach (F.)—Körpermessungen verschiedener Menschenrassen. Berlin, 1877.
- Weissenberg (S.)—Ein Beitrag zur Anthropologie der Turkvölker, Bashkiren und Meschtscherjaken. *Zeitschr. f. Ethnol.*, 1892, 314;—Die südrussischen Juden. *Arch. f. Anthropol.*, 1895, XXIII, 347–423;—Das Wachstum des Menschen nach Alter, Geschlecht und Rasse. Stuttgart, 1911.
- Werner (H.)—Anthropologische Beobachtungen über die Heikum-und Kungbuschleute. *Zeitschr. f. Ethnol.*, 1906, XXXVIII, 241–268.



## THE INCIDENCE AND HEREDITY OF FACIAL HYPERTRICHOSIS IN WHITE WOMEN<sup>1</sup>

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In the majority of women hair on the chin, cheeks and upper lip does not develop beyond fine unpigmented down similar to that covering most other parts of the body. Such a rudimentary condition of the beard is usually considered as typical of the human female. Some women, however, do have well developed beards (Le Double '12), and a slight growth of facial hair, particularly of the mustache is rather common. Cases of even moderate hypertrichosis are frequently ascribed to endocrine or other functional disturbances, although evidence in support of this assumption has never been marshalled in any very convincing manner. On the other hand the fact that many, probably the majority, of women with hypertrichosis are in every respect, except for the excess hair, typically feminine and without associated functional disturbances, raises the question as to whether the ordinary type of hypertrichosis may not be a simple variation in the hair itself. In order to get data bearing on this question we have attempted to determine the incidence of facial hypertrichosis in white women and to see how far heredity may be a factor in its production.

In individuals presenting this condition part of the hairs on the face and particularly those on the upper lip grow larger, develop pigment, and assume the characteristic of "terminal hair" (in the sense of Friedenthal '08). In the majority of cases the growth reached by the enlarged hairs is about that of the facial hair in boys at the time they begin to shave. In some women such a development of the hair is reached at or soon after puberty. Usually there is no very pronounced increase after the initial excess growth has occurred. There is some difficulty in correctly diagnosing the presence and degree of hypertrichosis in women when, as was the case in much of the work being reported, it is not practicable to get actual samples of the hair for microscopic examination. Blond hair on a skin with a moderately yellow cast is superficially much less conspicuous than is black hair on a very white skin. Some of the possibilities of error from superficial determinations have been

<sup>1</sup> Expenses incident to this investigation were paid from a fund given the Washington University School of Medicine for the study of hypertrichosis.

pointed out elsewhere by one of the writers (Trotter '22). The difficulties are somewhat increased by the frequent use of various means of depilation. The danger of overlooking more or less concealed cases is probably balanced to some extent by the possible faulty inclusion of an occasional individual with a strong contrast between the color of the skin and normal hair.

In the present study these deficiencies in our method were kept in mind and every effort was made to reduce the error to a minimum. All examinations were made in the most favorable illumination that could be obtained and were immediately recorded. The data are based on four groups of subjects: university students, clinic patients, insane patients, and a group of families in each of which one member was included among the clinic patients. Since there was no selection within the first three groups they may be used in a study of incidence of hypertrichosis in their respective classes. The fourth group is statistically available only for the study of the heredity of the condition.

The university students may be characterized as an apparently typical group of college women varying in age from 17 to 26. They were not selected in any way, all who presented themselves being examined. In this group there were 350 of whom 94 had definite facial hypertrichosis.

The clinic patients represented about the average, or perhaps a little better than the average, physical type of their class. All recorded were above sixteen years of age. No colored women are included in the series presented here but it may be noted in passing that they showed, contrary to what perhaps might have been expected, about the same incidence of hypertrichosis as did the white clinic patients. Of 660 white patients examined 185 showed hypertrichosis.

Since a possible association between hypertrichosis and insanity has been suggested (e.g. by Dupre and Duclos, '02, and O'Malley, '18), due perhaps to a common cause in endocrine disharmony, it seemed desirable to examine an adequate number of insane women. Thanks to the kindness and interest of Dr. A. J. Rosanoff it was possible to make such examinations under very favorable conditions at Kings Park, New York. Records were kept of the particular type of neurosis ascribed to each patient, but on analyzing the records later no significant difference could be found between the several classes, and the groups as a whole showed essentially the same incidence of hypertrichosis as found in women who were not insane. There were 686 white subjects over 16 years of age examined and of these 184 showed an excess of facial hair.

The figures for these three groups of subjects are summarized in Table I. The agreement between the groups is rather close and indicates

TABLE I.

## DISTRIBUTION OF HYPERTRICHOSIS IN THREE GROUPS OF WOMEN

Subjects	Without Hypertrichosis	With Hypertrichosis	Total Number	Percent with Hypertrichosis
Students	256	94	350	26.8
Clinic Patients	475	185	660	28.0
Insane	502	184	686	26.8
Totals	1233	463	1696	27.3

that the incidence of hypertrichosis, as here defined, is not far from 27 or 28 per cent among white women. In normal women Dupre and Duclos found the percentage to be 29 although they state that it is higher in the insane. Our data show no evidence suggestive of endocrine disturbance as a causative factor.

The fourth group was made up of two hundred families consisting in each case of the mother and various other relatives. In this study these mothers and the 388 of their daughters who are over 16 years old will be considered. This group obviously could not be used in determining the incidence of the trait since it represents specially selected families. The daughters under 16 years of age were excluded because of the impossibility of judging the amount of hair that might develop soon after puberty. Table II summarizes the data from these two hundred mothers and their daughters.

TABLE II.

## DISTRIBUTION OF HYPERTRICHOSIS IN MOTHERS AND DAUGHTERS

Mothers		Daughters		
		Number over 16 yrs. old	With Facial Hypertrichosis	Without Facial Hypertrichosis
With Facial Hypertrichosis	112	225	145 64%	80 36%
Without Facial Hypertrichosis	88	163	22 13%	141 87%



Considering the group of individuals shown in Table II and comparing mothers and daughters we find that normal mothers have 141 normal daughters and 22 with hypertrichosis, while mothers who have hypertrichosis have 80 normal daughters and 145 like themselves. Roughly computed this gives a coefficient of correlation between mother and daughter of about .8, which indicates a very strong hereditary tendency.

It remains now to inquire whether any more definite evidence as to the mode of hereditary transmission can be deduced from the data. We are confronted at this point with a serious difficulty in that we are as yet unable to recognize with certainty facial hypertrichosis or its equivalent in men. It is clear from the foregoing table that the trait is transmitted by mothers to their daughters. Since it thus seems to be dependent on the germplasm it is probable that fathers may also transmit the determiners for the condition to their offspring. On such a tentative assumption the following mode of analysis has been employed.

Knowing the incidence of an hereditary trait in a population at large it should be possible under certain conditions to construct a picture of the genetic constitution of that population with reference to the determiners for the particular trait in question. If such a trait is widely disseminated geographically and is not appreciably influenced by marriage or other form of selections its incidence should become stabilized in a human population just as Jennings ('16, '17) and others have shown that it should in lower forms. This stabilization implies that the numbers of individuals that are homozygous for a trait, that are heterozygous for it, and that do not carry it at all, will maintain the same relative proportions in the presence of random mating irrespective of changes in the total number in the population as a whole. Without entering into a detailed discussion of the question<sup>2</sup> it may be recalled that when the appearance or non-appearance of a trait is dependent on the distribution of a pair of allelomorphous genes the total number of the two alternative genes in the germ plasm of the whole population may be indicated as  $a+a'$  and the distribution of the trait will then depend on the ratio of  $a$  to  $a'$ , and on which of the two is dominant. In a population where matings are at random in respect to the trait, the distribution of the genes in their various combinations will be proportional to the algebraic expansion of  $(a+a')^2$ , or  $a^2$  individuals homozygous for one gene,  $2aa'$  heterozygous, and  $(a')^2$  homozygous for the other gene. If the first

<sup>2</sup> The fundamental principle involved in so far as they apply to animal cultures are fully discussed by Jennings (*loc. cit.*).

gene determines the appearance of a dominant trait, the incidence of that trait in the population at large will be  $\frac{a^2+2aa'}{(a+a')^2}$ , and this value will be large or small depending on the ratio of  $a$  to  $a'$ . Conversely, given the incidence of a trait in the population it is possible to determine the incidence of its causative dominant or recessive gene.

The danger that must be kept in mind in applying such a method as has just been indicated is the possible presence of such biasing factors as differential marriage rate or fertility. There is no evidence of reduced fertility associated with the ordinary type of facial hypertrichosis and we have not found any indication that it plays a significant role in marriage selection. Men who are the genotypical equivalents of women with hypertrichosis are not clearly distinguishable from others, so there can be no selection of them. Consequently so far as available data go, it seems safe to assume that matings are essentially at random so far as this trait is concerned. These considerations together with the general distribution of the trait make facial hypertrichosis a favorable subject for statistical study and help to compensate for the difficulty of properly classifying the male parents.

As already indicated the incidence of facial hypertrichosis may be assumed to be about 27%. If this is approximately correct and the trait is dominant, then the ratio of the dominant, hypertrichosis producing gene to its normal allelmorph should be as  $10 - \sqrt{100 - 27} : \sqrt{100 - 27}$  or about 15 to 85. This 15 and 85 correspond to the  $a$  and  $a'$  employed in a preceding paragraph and the distribution of types of individuals in the population should be proportional to the terms of the algebraic square of  $(15+85)$  or 225 homozygous for hypertrichosis (HH) to 2550 heterozygous (Hh) to 7225 (hh) who do not carry the trait at all. This is approximately 2 : 26 : 72 and represents the theoretical distribution of the determiners for the trait among women. Since there is no evidence to the contrary this may be taken also to represent the genotypical distribution of the trait among men. If marriages are wholly at random so far as this particular gene is concerned, the distribution of the several possible combinations and the proportion of different classes of children to be expected may be computed. Such a summary based on the assumption of a single dominant gene for hypertrichosis is presented in Table III.

From this table it appears that if facial hypertrichosis is due a single dominant gene mothers who themselves have hypertrichosis should when taken as a class, have 1695 daughters who show the trait to every

1105 who do not (17 : 11 or 60.7%). The observed figure corresponding to this hypothetical 60.7% is 64% (Table II) with a probable error greater than the difference, so that a practical agreement is indicated. Women who do not show the trait should have 1080 daughters with it to 6120 without (11 : 61 or 15%). Of women with hypertrichosis 1695 should have similar mothers to 1080 with normal mothers (17 : 11). We found the proportions to be 17 : 13 for the mothers of 53 women with facial hypertrichosis which, considering the numbers involved, is a rather close agreement.

TABLE III.

Wife	MATINGS		Frequency	EXPECTED RATIO OF DAUGHTER	
	Type	Husband		With Hypertrichosis	Without Hypertrichosis
HH		HH	$2 \times 2 = 4$	4	0
HH		Hh	$2 \times 26 = 52$	52	0
HH		hh	$2 \times 72 = 144$	144	0
Hh		HH	$26 \times 2 = 52$	52	0
Hh		Hh	$26 \times 26 = 676$	507	169
Hh		hh	$26 \times 72 = 1872$	936	936
When mothers have hypertrichosis				1695	1105
hh		HH	$72 \times 2 = 144$	144	0
hh		Hh	$72 \times 26 = 1872$	936	936
hh		hh	$72 \times 72 = 5184$	0	5184
When mothers do not have hypertrichosis				1080	6120

If on the other hand the trait were due to a recessive gene, mothers with hypertrichosis should have 52% of their daughters like themselves and normal mothers should have 18% with hypertrichosis. Women showing the trait should have mothers like themselves about as often as not (14 : 13). If the trait were due to the concomitant action of more than one recessive gene the difference between observed and expected data could not be reduced whatever incidence might be assumed. Two dominant genes on the other hand, each with its own peculiar incidence might be so postulated as to make the expectation almost as close to the observed figures as when only a single one is assumed.

In a few cases where the mother was classified as normal and the father appeared to be rather deficient in facial and bodily hair some of the daughters showed marked hypertrichosis. This might seem to indicate the presence of multiple or modifying factors, or it might indicate that the real factor for hypertrichosis does not make its presence mani-



fest in the male. A third possibility is that while facial hypertrichosis is prevailing a definitely hereditary trait a certain number of instances are spontaneous in origin as seems to be the case with many other typically hereditary conditions.

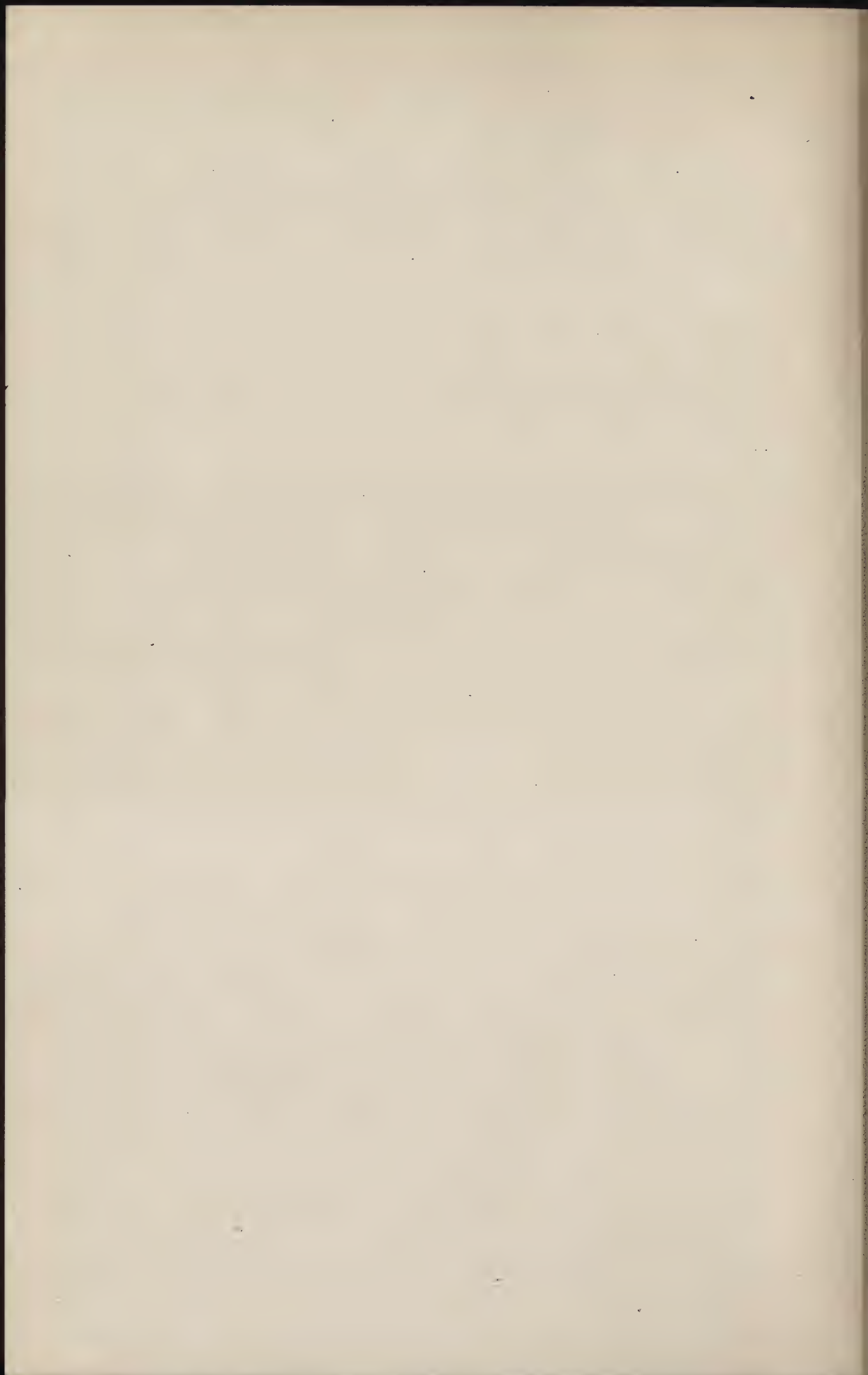
The data presented in this paper do not necessarily disprove the assumption that hypertrichosis may be an element in certain syndromes involving psychopathic or other abnormal conditions, but since the incidence is essentially the same among college girls, clinic patients and insane women we find little support for the idea that the milder forms at least are to be considered as having any pathological significance.

The frequency of hypertrichosis, the apparent normality of many women who show the trait, and its hereditary behavior indicate that the ultimate cause of the condition is to be sought in relatively stable germinal factors. That these factors may operate in part through the medium of an endocrine complex is a possibility comparable to some of the possibilities suggested by Keith ('19) and others to explain a variety of heritable bodily differences. It is quite probable on such an assumption that pathological involvement of the endocrine system may be responsible for a certain number of, mostly aberrant, cases of hypertrichosis, but the number of such cases can represent only a small fraction of those met in the routine examination of an unselected population.

In short, the observations reported in this paper indicate that a more or less excess growth of hair appears on the faces of about a fourth of white American women during the early years of their adult life, and that this form of hypertrichosis represents a normal hereditary condition.

#### LITERATURE CITED

- Dupré and Duclos. La barbe chez les aliénés. XI Congrès des aliénistes et neurologistes français. (Reviewed in *Annales de Dermatologie et Syphilis*, 1902, III : 806.
- Friedenthal, Hans. Das Haarkleid des Menschen. Gustav Fischer, Jena. 1908.
- Jennings, H. S. The Numerical Results of Diverse Systems of Breeding. *Genetics*, 1916. I : 53-89.
- Jennings, H. S. The Numerical Results of Diverse Systems of Breeding, with Respect to Two Pairs of Characters, Linked or Independent, with Special Relation to the Effects of Linkage. *Genetics*, 1917. II : 97-154.
- Keith, Arthur. The Differentiation of Mankind into Races. *Lancet*, Lond., 1919. II : 553-556.
- LeDouble, A. F., et Houssay, François. Les Velus. Vigot Frères, Paris. 1912.
- O'Malley, Mary. Certain Pluriglandular Anomalous Functions Associated with Psychopathic Sexual Interests. *J. Nerv. & Ment. Dis.*, 1918. XLVIII : 1-35.
- Trotter, Mildred. A study of Facial Hair in the White and Negro Races. Washington University Studies, Scientific Series, 9 : 1922, 273-288.



## NOTES

The XI International Congress of Geography and Ethnology will meet in Cairo, Egypt in March, 1925. Address of Secretary-General—Rue Cheikh Youssef, No. 45, Cairo.

The XXI International Congress of Americanists will be held in 1924 partly in Holland and partly in Sweden (Gothenburg). In addition it is expected that invitations for a one or two-days' visit will be received from Christiania and Copenhagen.

The first International Congress of Slav anthropologists (comprising anthropology in its broadest sense with especial attention to that of the Slav countries) will be held in Prague in 1924, immediately following the Congress of the Americanists.

*New Periodical.* A new quarterly devoted to physical anthropology has been established at Prague, Czechoslovakia under the auspices of the Anthropological Institute of the Czech University. The journal will be known as the "Slovanská Anthropologie"; and will be under the editorship of Prof. J. Matiegka, assisted by the foremost representatives of physical anthropology in the different Slav countries. Its objects will be to foster and serve physical anthropology in these countries; to keep the world acquainted with Slavic anthropological work and publications; and to bring to the notice of Slav workers the progress of anthropology in the rest of the world. All original articles will be accompanied by an abstract in English or French; and papers as well as reviews may be published in these languages. The financial side of the undertaking has been assured by a suitable foundation. Subscriptions (\$4) may be sent to the "Anthropologický Ústav, na Karlově, Čech University, Prague, Bohemia, Czechoslovak Republic.

The anthropological collections of the U. S. National Museum relating to Early Man have recently been enriched by the acquisition of excellent firsthand casts of the restored La Quina skull and jaw; of the Obercassel crania; of the Ehringsdorf two lower jaws with a piece of a skull; of a series of the most important of the Předmost crania and intracranial casts; of the two molars of *Pithecanthropus* (gift of Professor J. H. McGregor); and of the tooth of the "*Hesperopithecus*" (donated by the American Museum of Natural History).



*Man of Ehringsdorf.* The latest find in the Ehringsdorf travertine beds is that of a primitive human femur. The specimen, which is said to present the characteristic Neanderthal features, has not yet been described, and is not as yet available for study by visitors.

*The Bañolas Jaw.* A cast of the Bañolas jaw may now be seen in the Anthropological Museum of the University of Madrid (Prof. Antón). The original is still in the possession of the owner near Barcelona. The features shown by the cast are somewhat disappointing, the specimen being not quite as primitive as suggested by the published illustrations.

*The Boskop Skull.*—The supposedly ancient Boskop skull from South Africa, which so far has not received a satisfactory description, is being carefully studied by Professor W. P. Pycraft of the British Museum.

*Aymara Deformation in North America.* The U. S. National Museum has recently received two skulls, from points in northwestern and southwestern Missouri, both of which show unmistakably a moderate degree of Aymara deformation. These are the first occurrences of this nature from the North American mainland. The nearest points where a similar deformation has been practised are Vancouver Island and Peru. A more extended note on the find will be published in "Science."

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